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Science

Jaime Torres Bodet

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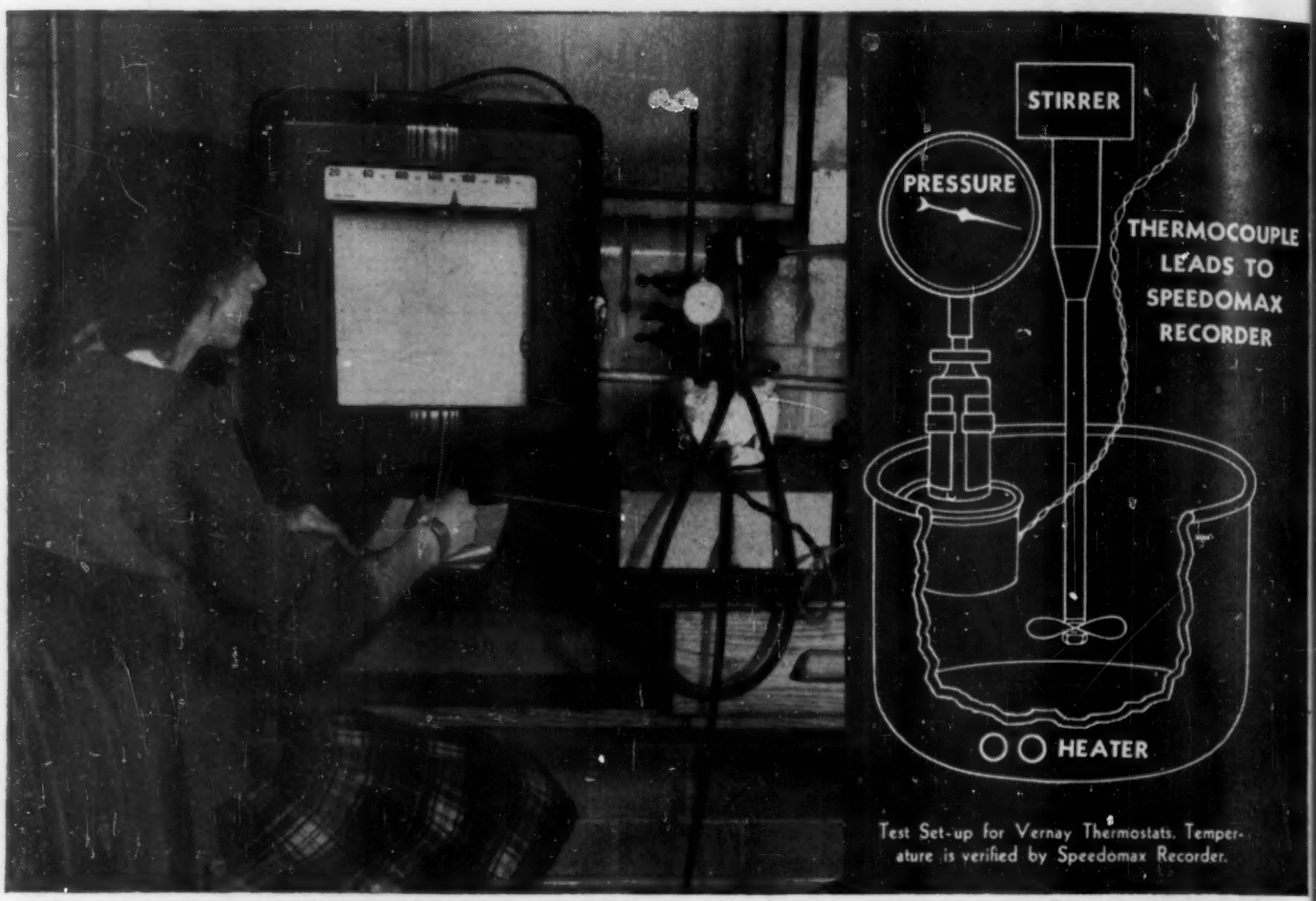
(See page 734)



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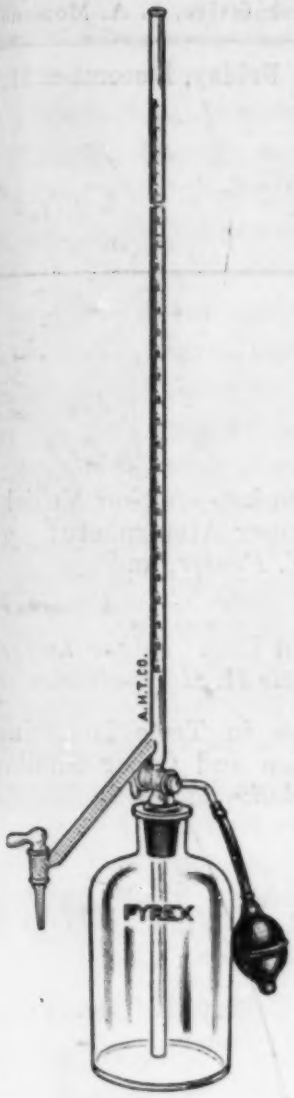

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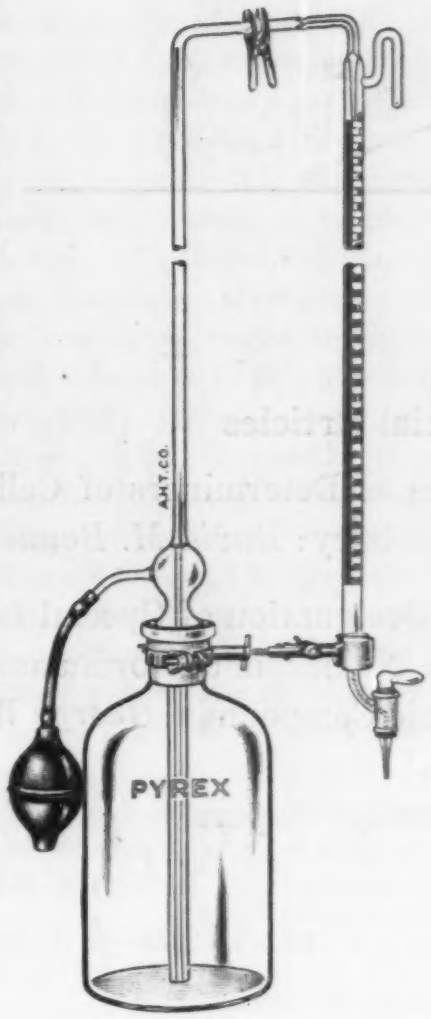

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Genes as Determiners of Cellular Biochemistry

David M. Bonner
Department of Botany and Microbiology, Yale University

THE SCIENCE OF GENETICS was born, and has matured, within the 100 years we are now celebrating. It stems from the acute observations of Mendel nearly a century ago regarding the inheritance of morphological traits in plants. Many years later, T. H. Morgan and his collaborators, working with the ubiquitous fruit fly, gave precise definition to the smallest unit of inheritance, the "gene." Genes are an integral part of the chromosome, arranged in linear order in it, and specific genes are associated with specific hereditary traits. The ingenious work of many investigators has made it possible to map out in considerable detail the relative positions (loci) of a great number of genes on the chromosomes of *Drosophila* and of corn, despite the fact that no gene has ever been seen. We also have extensive knowledge of gene interactions as well as of the gross chemical nature of chromosomes. How a gene determines a specific hereditary character, however, is not as well understood. The progress made in this field in the past several years has been remarkable. There remain, however, great gaps in our understanding of this phenomenon. The mechanism whereby genes can control specific morphological traits, *i.e.* the mechanism of gene action, is not well understood, and we know less still concerning the process that enables a gene to make exact replicas of itself at each cell division. It is the problem of gene action which I plan to discuss at this time.

During the past 20 years considerable evidence has been marshalled by investigators using the fruit fly and corn which suggests that genes probably exert their morphological control through the control of biochemical reactions. In fact, some of the earliest evidence of this relationship stems from the study of hereditary diseases in man, particularly those centering around the metabolism of the two amino acids, phenylalanine and tyrosine. The genealogy of families afflicted with diseases such as alcaptonuria pointed many years ago, toward the genic control of biochemical reactions. Organisms such as man, corn, or fruit flies, however, possess many disadvantages for this type of research. Therefore, in 1941 the geneticist, Beadle, and the biochemist, Tatum, cast about for a better organism with which to make a critical study of gene action and found one ready-made in the bread mold, *Neurospora crassa*. The life cycle of this organism had been worked out by the mycologist, Dodge, and the usefulness of *Neurospora* as a genetic tool had been demonstrated by the geneticist, Lindegren. This fungus is a favorable organism for such investigations. Its nutritional requirements are simple, and it can be grown on a chemically defined medium. It will grow on a medium containing sucrose as a carbon source, nitrate as a nitrogen source, inorganic elements, and the vitamin biotin. From a genetic standpoint *Neurospora* is easily worked with. It exists in two strains of opposite mating type and in its vegetative phase has a single set of chromosomes and genes. Problems of dominance do not therefore arise.

Using this organism, Beadle and Tatum argued that, if genes do indeed control biochemical reactions, it should be possible to induce gene mutations that would affect the synthesis of such vital cellular components as vitamins and amino acids. Such mutations could be detected by the fact that any strain in which such a mutation occurred would then be dependent upon an external supply of this compound. These workers, therefore, subjected asexual spores to agents known to increase the mutation frequency in other organisms, such as X-ray or ultraviolet irradiation. Since the asexual spores are multinucleate, the treated spores were crossed with the opposite mating type of the parental strain to permit segregation of the mutant nuclei. These isolated strains were then established on a complex medium containing yeast extract and hydrolyzed casein as sources of additional growth factors. After the strains were established on this medium, they were transferred to the minimal synthetic medium capable of supporting the growth of the original strain. Most of the isolated strains grew equally well on both media, but an occasional strain appeared which grew well on the complex medium and not at all on the minimal synthetic medium. Using appropriate testing techniques, the factor present in the complex medium and absent in the minimal was then identified, and has proven in most cases to be a known vitamin or amino acid. These occasional strains, therefore, differ from the parental strain in that they require for growth one additional substance furnished in the medium. Included in the list of com-

This paper was presented in the Symposium on Genes and Cytoplasm, held in Washington, D. C., during the Centennial Celebration of the AAAS.

pounds which have been found to be required by various mutant strains of *Neurospora* are all of the B-vitamins, most of the known amino acids, and several of the purines and pyrimidines. That these limited classes of substances have been found in this type of work does not imply lack of genic control of the synthesis of other types of cellular constituents. It reflects, rather, the limitations imposed by existing methods of detection.

As just mentioned, requirements for the various B-vitamins and for numerous amino acids have been found in these mutant strains of *Neurospora*. Is such a biochemical trait hereditary? It is quite simple to perform the proper genetic tests to ascertain the heritability of such a character. For example, numerous strains are known which require either niacin or niacinamide for growth, in addition to the growth requirements of the parental strain. Such a niacin-requiring strain, when crossed with the opposite mating type of the parental strain, gives rise to fruiting bodies which contain sacs (asci) of 8 spores (ascospores). All of these spores, if dissected out and grown separately on a synthetic medium containing adequate niacin, will grow. However, if they are now tested for their ability to grow on the minimal synthetic medium in the absence of niacin, only half of the cultures will grow, *i.e.* half of the spores require niacin, and half of the spores are niacin-independent. The requirement for niacin is inherited, therefore, as a single gene difference between the mutant and parental types. All of the niacin-requiring strains, when crossed with the parental strain, are similarly found to differ from it by alteration of a single gene. Thus, all of these strains represent single gene changes from the wild type. It is of interest to determine whether they all differ from the wild type by alteration of the same gene or whether they represent alterations of several different single genes. This problem is easily settled by crossing the various strains with each other. If the same gene is represented in each case, one would expect that in the spores resulting from the cross only niacin-dependent spores would be found. If they represent different genes, on the other hand, and the genes are not closely linked, one should expect to find an occasional ascus containing some wild type spores, as a result of crossing over. This experiment has been carried out with the niacin-requiring strains, and at least four separate genes have been located which are essential for the synthesis of niacin. Alteration of any one of these four genes gives rise to a niacin-dependent culture.

This type of genetic investigation, though not as yet carried out for all of the known nutritional mutants, has been carried out with a great many of the strains. Each case of a nutritional deficiency which has been examined genetically has been found to be the result of a single gene difference between the mutant and parental types. In general, it has also been observed that several genes are concerned with the synthesis of each of the vitamins and amino acids. It has also been possible to construct a genetic map of the biochemical characters which have been found for *Neurospora*. McClintock has examined *Neurospora* cytologically and has found it to have 7 chromosomes. Using standard genetic techniques for mapping genetic characters, the various biochemical characters have been located on these chromosomes, and we now believe we have at least one character for each of the 7 linkage groups.

The next question to arise is whether the biochemical consequences of these mutations can be analyzed more critically. The investigations of cellular biochemists during the past two decades have been particularly brilliant in exploring the metabolism and synthesis of carbohydrates. Indeed, we now know that a polysaccharide is utilized by a cell in a well-ordered sequence of reactions. Our knowledge of the biosynthesis of vitamins and amino acids has not been nearly so extensive. However, investigations aimed at elucidating the biochemical nature of genetically blocked reactions have proven useful in understanding the biosynthesis of vitamins and amino acids. Biochemical investigations using mutant strains of *Neurospora* have shown that such vital cellular constituents as vitamins and amino acids are also synthesized in characteristic series of sequential reactions, and that the general pattern of synthesis is similar for *Neurospora* and higher plants and animals.

From the existing literature one may draw many examples for illustrative purposes. Although neither of the two series of reactions chosen here are the most completely understood series, both of them will serve to illustrate the different biochemical problems that arise as a result of genic alteration.

As was mentioned earlier, there are known to be at least four genetic types which require niacin for growth. Can these also be broken down into four distinct biochemical groups? Biochemical investigations by Beadle and his collaborators at the California Institute of Technology and by investigators at Yale University have shown that they can. Strains of three of the groups will grow well on niacin and will not grow on the amino acid tryptophane. Strains of the fourth genetic group, however, will grow on either niacin or tryptophane. These are therefore obviously biochemically distinct from the other three genetic types. The latter classes may also be shown to differ biochemically from one another, since strains of one

class will grow equally well on either niacin or hydroxyanthranilic acid, while strains of the other two classes will grow only when supplied with niacin. The two remaining types are differentiated by the fact that strains of one type, when grown on niacin, invariably excrete hydroxyanthranilic acid into the culture medium, whereas the remaining type does not. Thus, these four genetic types appear to correspond to four distinct biochemical types.

Can such biochemical differences be more precisely defined in terms of specific reactions? Several strains of *Neurospora* are known to require tryptophane for growth, and this requirement in these strains cannot be replaced by niacin. These can also be broken into three distinct biochemical classes: class 1, those which can use only tryptophane for growth (*2*); class 2, those which can use either indole or tryptophane for growth; and class 3, those which can use anthranilic acid as well as indole and tryptophane for growth (see Fig. 1). Inasmuch as no mutants have been found which can grow on indole alone, yet cannot utilize tryptophane, indole is established as a precursor of tryptophane. Mutants of class 1 not only differ from the parental type by alteration of a single gene, but they also differ genetically from the other biochemical classes. Biochemically, strains of class 1 have been characterized precisely and are known to differ chemically from the parental type through the loss of a single specific biochemical reaction, viz., the coupling of indole with the hydroxy amino acid serine. Mutants of class 1 have therefore lost the ability to carry out a single specific biochemical reaction by alteration of a single gene. This example is not unique, since many single gene mutations involved in the synthesis of such other compounds as choline, arginine, or methionine are also correlated with the loss of single known reactions. Our present inability to define the reactions blocked in the niacin series, as well as in classes 2 and 3 of the tryptophane series, simply reflects the inadequacy of our knowledge concerning the cellular synthesis of niacin and indole, respectively. All of those strains, however, presumably represent losses of single reactions.

The second series of reactions which I would like to mention deals with mutant strains requiring the two amino acids, isoleucine and valine. A mutant strain has been obtained which differs from the parental type by a single gene change and which requires isoleucine and valine for growth. Detailed investigation has shown that this double requirement is not the result of a common biosynthetic step in the synthesis of these two amino acids. Rather, it has been found that the genetic block prevents the amination of the keto acid analogue of isoleucine. As a result of this block, the keto acid analogue of isoleucine accumulates and in turn competitively inhibits the amination of the keto acid of valine. Thus, the genetic block in one biosynthetic step in this instance results in an apparent double requirement. This example illustrates an important fact regarding these mutant strains. Though the genetic block can be obviated by supplying the necessary end-product, these strains are still not biochemically wild type, since one must still reckon with the fate of the substrates that accumulate abnormally as the result of loss in one biochemical reaction.

Biochemical investigations, in short, show that a gene mutation which gives rise to a growth-factor requirement represents, in reality, a loss of the ability

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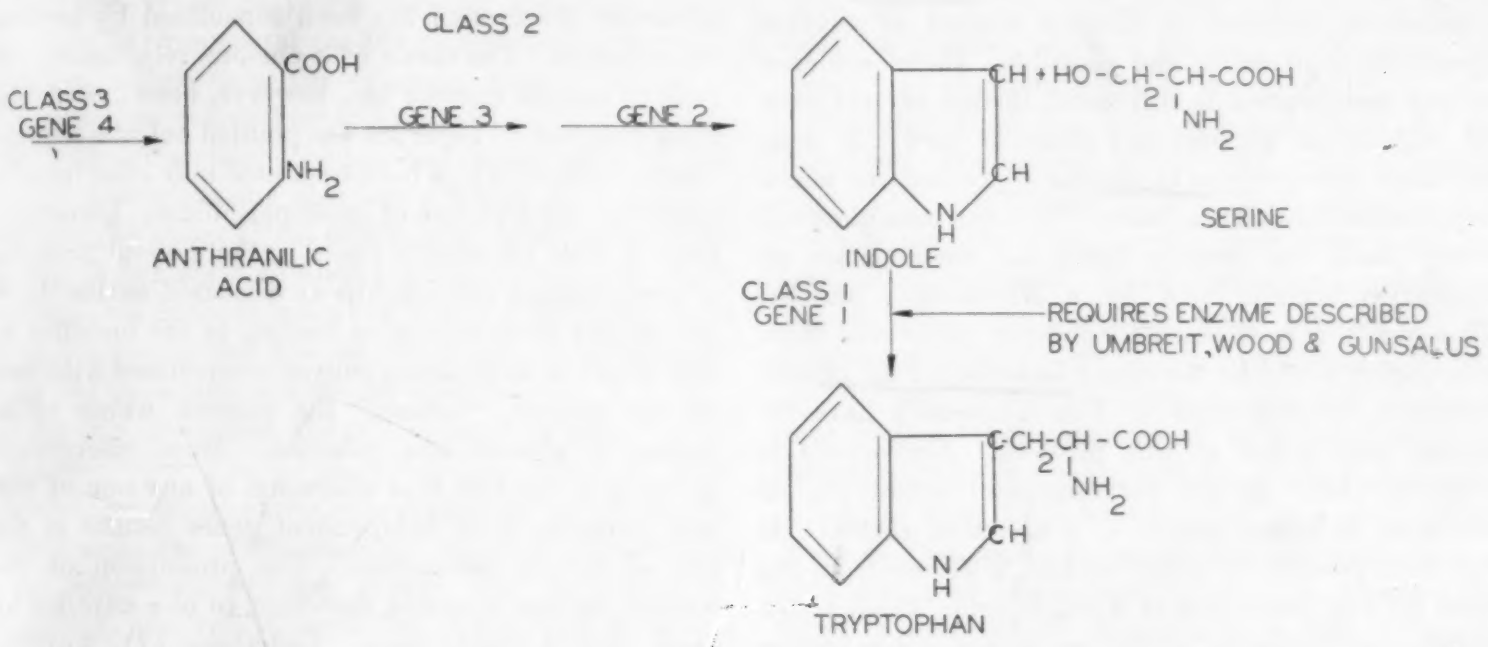

FIG. 1

to carry out a specific biochemical reaction. This view is further supported by the fact that independent mutations of the same gene invariably are associated with loss of the same biochemical reaction. These observations have in turn led to the working concept that single genes control single biochemical reactions. This concept has frequently been referred to as the one-one hypothesis, and we shall return to it later.

Having now seen the evidence for assuming that single genes control single biochemical reactions, can we probe more deeply into the nature of this control? It is here that the evidence becomes very much weaker. It has often been postulated that genic control is exercised through control of enzyme specificity. Since nearly all biochemical reactions require enzymatic catalysis, the assumption that the genetic control of biochemical reactions is through control of enzyme specificity is attractive and plausible. Direct evidence of any such control is still scant, though several lines of evidence do support this point of view. If gene mutation does give rise to enzyme alteration, one might expect substrate accumulation. This has been observed many times, one example being the accumulation of hydroxyanthranilic acid by a *Neurospora* mutant. However, this is at best only indirect evidence. More convincing would be the direct isolation of an altered enzyme. Investigations at Yale University have recently been aimed at this problem. *Neurospora* is capable, under proper environmental conditions, of adapting to utilize lactose as a source of carbon. It has been possible to isolate strains, differing from the wild type by alteration of a single gene, which under similar environmental conditions cannot utilize lactose as a carbon source but will grow on sucrose. An enzyme has been prepared in cell-free extract from the parental type which will split lactose to glucose and galactose. In preliminary experiments this enzyme has not been found in the mutant. In this instance, then, the loss of a specific biochemical function appears to be associated with mutation of a single gene and also with lack of production of a specific enzyme. Recently, Mitchell and Lein (*2*) have made similar observations regarding the enzyme, described by Umbreit, Wood, and Gunsalus, for the condensation of indole and serine to the amino acid tryptophane. Mitchell and Lein have found this enzyme lacking in those mutants, discussed earlier, which require tryptophane for growth and which are unable to replace this tryptophane requirement by indole. Here, then, is a second instance in which a gene alteration leading to the loss of a specific biochemical function is associated with the absence of a specific enzyme. These observations, while aiding the argument that genes do control enzyme production, do not contribute critical proof of genetic control of enzyme specificity. The correlation of altered gene to altered enzyme, rather than simple loss of enzyme, is yet to be established.

The biochemical and genetic observations which have just been reviewed lead to the conclusion that single genes control single biochemical reactions, and that this control is exercised through control of enzyme production. These conclusions have given rise to the thesis that a one-one relationship exists between gene and biochemical reaction, and that this is the reflection of a more fundamental relationship existing between genes and enzymes, *i.e.* that single genes determine the specificity of single enzymes. There is considerable logic in this point of view, since the evidence at hand suggests that genes are nucleoproteins. The possibility that the gene serves, therefore, as a template in determining the final configuration of the enzyme is an attractive theory and has been considered by several investigators. The thesis of a one-one relationship of gene to specific enzyme has, however, been justifiably criticized, and, as Delbruck has pointed out, the experimental methods which have been used may have largely precluded the detection of incompatibilities. Investigations at Yale University aimed at the general problem of gene-enzyme relationship as discussed earlier have shown that genic alteration leading to the inability to utilize lactose as a carbon source is correlated with loss of the enzyme, "lactase," the enzyme which splits lactose to glucose and galactose. More interesting, however, is the fact that alteration of any one of two and probably three independent genes results in the loss of lactase production. The production of the enzyme, lactase, appears, therefore, to be controlled by more than a single gene. Lederberg (*1*), working with the bacterium *E. coli,* has also recently observed that alterations of any one of 7 independent genes affects lactase production in this organism. These preliminary data suggest that enzymes, as other cellular constituents, are synthesized by a characteristic sequential series of biochemical reactions. The various characteristic biochemical reactions in the synthesis of a given enzyme undoubtedly are enzymatically catalyzed. Such considerations, however, emphasize the difficulty attendant in a thesis such as a one-one relationship of gene to specific enzyme, since it is difficult in our present state of knowledge to decide whether enzyme specificity is a property conferred upon an enzyme in the final stage of synthesis or whether specificity represents the logical culmination of its entire characteristic synthesis. How might one then sum up current thoughts concerning the relationship of gene to biochemical reaction? Single genes are known to control single biochemical reactions, and this control is probably exerted through control of enzyme production. The nature of the relationship existing between gene and enzyme remains a major biological enigma.

One might next logically question whether the theory that genes control enzyme production fits in suitably with known genetic relationships. It is obvious that it cannot account fully for all of the known complicated biological data. Our knowledge regarding the more intimate structure and properties of proteins is scant indeed, and with genes one is likely dealing with the most complicated type of protein, a nucleoprotein, a self-duplicating particle. Many genetic phenomena are, however, certainly accounted for in part by such a theory as, for instance, multiple allelism. If genes do control enzyme production, it is possible that various alterations of a given gene might lead to enzymes of various types or to an enzyme entirely lacking specificity for its customary substrate. On the other hand, a less drastic gene alteration might give rise to an enzyme possessing specificity under certain environmental conditions and lacking it under others. There are, for example, mutant strains of *Neurospora* which are different from the wild type only under certain conditions of temperature or pH, while allelic strains also occur which are mutant in phenotype under all conditions of temperature and pH. Many other sorts of alleles could probably be found if suitable methods were available for detecting them, e.g. forms showing altered efficiencies, forms converting the substrate to different end-products.

In this discussion the relationship of gene ⟶ product ⟶ morphology has been omitted. Morphological changes have been repeatedly observed after the irradiation of *Neurospora*. Inositol concentration can determine whether growth will be diffuse or colonial, and recent work has shown that numerous compounds can produce effects which simulate that of a single gene known to control growth habit. These phenomena cannot, however, be precisely defined biochemically. That decided morphological changes might be occasioned by subtle enzyme changes is fascinating speculation, genetic evidence for which Stern has now presented.

Nearly every biochemical reaction that occurs in a living cell requires enzymatic catalysis. Since genes are necessary for the production of each of these enzymes, the question is often raised: Does not a cell require an astronomical number of genes, inasmuch as the number of cellular reactions is undoubtedly large? Although an answer to this question must be largely speculative, the order of magnitude of the number of genes estimated by geneticists to be present in various organisms is 10,000. Are 10,000 enzymes sufficient to run a cell? I suspect so. It is of importance to remember that enzymes have relative specificity, and that tremendous variation in structure of large molecules such as proteins can theoretically be achieved by relatively few enzymes. Furthermore, if one adds up all of the reactions necessary to synthesize all of the vitamins, amino acids, purines, pyrimidines, and all of the reactions necessary for the metabolism and synthesis of polysaccharides, the total is still only of the order of 1,000, leaving scope for at least 10 times as many other sorts of reactions. Thus, at present no serious disparity between the number of reactions vital for a living cell and the number of genes that such a cell probably contains is apparent.

This discussion has dealt primarily with the one organism, *Neurospora*. This has been deliberate, since at the present time *Neurospora* presents in many respects the best material for correlating genic and biochemical changes. Many important speculations and investigations resulting from the use of biochemical mutant strains of microorganisms have been omitted, and instead the emphasis has been placed on gene action. Genic control of biochemical reactions undoubtedly holds equally well for all other organisms; it has, in fact, been demonstrated in a great many. There is little reason to believe that the mechanism of gene action in microorganisms such as bacteria and fungi is substantially different from that of macroorganisms, such as insects, higher plants, and mammals. *Neurospora* has served well for relating genes to biochemical reactions, but it may well not be the best possible material with which to tackle the problems that the future holds for us in this field. The relationship of genes to enzymes will undoubtedly be different from that which we envisage at the present time, but will probably prove even more exciting.

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The Designation of Special Isotopes in the Names and Formulas of Inorganic Compounds

George W. Watt

The University of Texas, Austin, Texas

RAPID EXPANSION OF THE SCIENTIFIC LITERATURE relating to work involving special isotopes of the chemical elements provides ample evidence for the need for standardization of isotope designation as an integral feature of systematic nomenclature. That the extent of use of special isotopes—both stable and radioactive—has far exceeded the expectations of some is reflected by the prophetic inaccuracy of the following statement by Otvos and Wagner which appeared only a little more than a year ago: "It is unlikely that isotopes other than deuterium will soon be available in high purity" (*Science,* October 31, 1947, p. 409).

Although some attention has been given to these matters—for example, by Otvos and Wagner (*loc. cit.*), Crane (*Science,* July 27, 1934, pp. 86–89), Dauben (private communication to Crane, January 6, 1947), and Silverman (*Chem. Eng. News,* 1947, 25, 806)—it is only within the past year that comprehensive studies have been made in relation to the specific problem of *inorganic* substances.

Listed below are a number of recommendations and, where necessary, an indication of their limitations, some of the reasons for their adoption, etc. It should be understood at the outset that these proposals assume that the species separately designated are present in the compound in substantially isotopically pure form. For example, we are concerned primarily with the case in which $BaC^{14}O_3$ contains C^{14} almost exclusively rather than ordinary $BaCO_3$ partially enriched with respect to $BaC^{14}O_3$ or merely "spiked" with C^{14} "tracer." This does not, however, preclude the possibility of applying the rules to the latter cases provided the accompanying text makes it clear, for example, that a tracer technique is involved.

Rule 1. *In both the formulas and names of inorganic compounds, special isotopes are designated by mass numbers supplemented where necessary by the appropriate symbols.*

Implicit in this rule is the conclusion that elemental constituents not specifically designated by mass number are present in the isotopic composition of natural occurrence.

It is not considered necessary to show in either the name or the formula whether the isotope in question is stable or radioactive. Although there is much to be said in favor of relieving the reader of the need to know which isotopes are active and which are stable, both formulas and names become unduly cumbersome when an attempt is made to incorporate this and other items of information that might otherwise seem desirable.

For those cases in which isotopic mixtures other than those of natural occurrence are present, all of the appropriate mass numbers are included.

Rule 2. *In all symbols and formulas, the mass number is written as a right superscript.*

This practice represents a deviation from the recommendation included in the 1940 report of the International Union of Chemistry (Jorissen, *et al. Ber.,* 1940, **73A**, 53; *Helv. chim. Acta,* 1940, **23**, 997, 1012; *J. Amer. chem. Soc.,* 1941, **63**, 889) and emphasizes the divergence in American and European practice. The latter almost uniformly corresponds to the International Union's recommendation that mass numbers be written as left superscripts (e.g. ^{144}Pr) and that the right superscript position be reserved for its traditional indication of ionic charge or oxidation state. American practice, on the other hand, is equally uniform among both chemists and physicists, but the mass numbers are written as right superscripts (e.g. Pr^{144}).

Silverman has suggested that the mass numbers be written directly above the appropriate symbols and that the redundant nuclear charge be written below. In view of its obvious disadvantages, it seems unlikely that this suggestion will receive serious consideration.

Rule 3. *In the names of inorganic compounds, a special isotope is designated by insertion of the mass number immediately following the appropriate part of the systematic name. The mass number is set apart by a hyphen or hyphens and preceded by the corresponding symbol whenever the compound involves two constituents having overlapping ranges of mass numbers.*

In effect, it is proposed that the systematics of special isotope designation should be as nearly as possible compatible with the nomenclature practices sponsored by the International Union. The broad applicability of this general rule has been examined in relation to a large number of inorganic compounds, both simple and complex. Application of Rule 3 to

considerable number of typical cases is illustrated the following examples:

$Fe_2{}^{59}O_3$ Iron-59(III) oxide

Where both mass number and designation of oxidation state are included, the mass number stands first.

$N_2O_4{}^{18}$ Dinitrogen tetroxide-18

Even if there were a nitrogen isotope of mass 18, the position of the mass number in the preceding name is such that it applies only to oxygen.

$Na_4{}^{24}Pb_9$ Tetrasodium-24 eannaplumbide

$Co_2{}^{58}(CO)_8$ Dicobalt-58 octacarbonyl

$Co_2(C^{14}O)_8$ Dicobalt octacarbonyl-C14

$Co_2(CO^{18})_8$ Dicobalt octacarbonyl-18

Unlike the case of dinitrogen tetroxide-18, in which the mass number is appended to that portion of the name which relates to only one component of the molecule, the last two of the preceding examples involve the name of a group consisting of two elements having contiguous ranges of mass numbers. Thus, although there is no known oxygen isotope of mass 14, the possibility of misunderstanding is decreased if the symbol for carbon is included. A still better example is provided by the cyanide group, for in this case the appended mass numbers 13 or 14 might apply to either carbon or nitrogen. Consequently, the inclusion of the symbols would be entirely necessary for clarity. While some may feel that the symbol should always accompany the mass number, maximum simplification requires that the symbol be dispensed with wherever this may be done without loss of clarity. In many borderline situations, inclusion of the symbol, even though not entirely necessary, is considered within the intent of the rule.

$Na_2V_4{}^{48}O_{11}$ Sodium tetravanadate-48

Should one choose to employ a systematic name based upon the resolved formula, one would write sodium (1:2) vanadate-48. There are undoubtedly a few instances in which the inclusion of arabic numbers for purposes other than special isotope designation might lead to difficulties, but these should be rare.

$(N^{15}H_4)_2SO_4$ Ammonium-15 sulfate

$(NH_4)_2S^{35}O_4$ Ammonium sulfate-35

Certainly neither of these two cases should cause any uncertainty with reference to the proper application of the mass numbers specified.

$Na_2SS^{35}O_3$ Sodium thio-35-sulfate

$Na_2S^{35}SO_3$ Sodium thiosulfate-35

$Na_2S_2{}^{35}O_3$ Sodium thio-35-sulfate-35

These three examples represent a case in which exchange experiments have demonstrated structurally discernible differences between like atoms (Voge and Libby. *J. Amer. chem. Soc.*, 1937, **59**, 2474; cf. Voge. *Ibid.*, 1939, **61**, 1032). Specification of the position of the special isotope requires repetition of the symbol for sulfur in the formula, while repetition of the mass number (in the name) appears desirable when the special isotope is present in both positions. With general reference to this kind of problem, it may not be anticipated that all other cases may be handled thus simply.

$K_2HP^{32}O_4$ Dipotassium hydrogen phosphate-32

$H_3PO_2S_2{}^{35}$ Dithio-35-phosphoric acid

$H_3P^{32}O_2S_2$ Dithiophosphoric-32 acid

The mass number 32 in the latter case clearly implies P^{32}, for if it were meant to apply to sulfur, the position of the mass number would be the same as in the second of the three cases.

$CaCl_2{}^{36} \cdot 8NH_3$ Calcium chloride-36 8-ammoniate

$CaCl_2{}^{36} \cdot 8N^{13}H_3$ Calcium chloride-36 8-ammoniate-13

$CaCl_2{}^{36} \cdot 8NH_3{}^2$ Calcium chloride-36 8-ammoniate-2

In the nomenclature of solvated salts it seems unlikely that the arabic numbers which show extent of solvation could lead to confusion, in view of the fact that they invariably precede rather than follow the name which indicates the nature of the solvation (*i.e.* hydrates, peroxyhydrates, ammoniates).

It will be observed that in the last of the preceding examples, specification of H^2 omits both the symbol D and the corresponding name. It is believed that the use of separate names and symbols for specific isotopes should be discouraged in every way possible. This particular hydrogen isotope is not truly a unique case in any important respect, and it may, in fact, come to assume a relatively minor role as a result of the recently announced availability of H^3. There appears to be no particular merit in the incorporation of the Boughton system (Crane, *loc. cit.*), for the nomenclature of compounds containing H^2, within the framework of systematic inorganic nomenclature.

$(CH_3)_2Ga^{72}(BH_4)$ Dimethylgallium-72 tetrahydroborate

$(CH_3)_2Ga(B^{10}H_4)$ Dimethylgallium tetrahydroborate-10

$(C^{14}H_3)_2Ga(BH_4)$ Dimethyl-14-gallium tetrahydroborate

$(CH_3{}^2)_2Ga(BH_4{}^2)$ Dimethyl-2-gallium tetrahydroborate-2

The foregoing examples provide additional applications of the general rule and include a case in which

a special isotope is present in two different positions in the same molecule.

$K[Au^{198}(OH)_4]$

Potassium tetrahydroxoaurate-198(III)

$K[Au^{198}(O^{18}H^3)_4]$

Potassium tetrahydroxo-18,3-aurate-198(III)

$Fe_4^{59}[Fe(CN)_6]_3$ Iron-59 hexacyanoferrate(II)

$Fe_4[Fe^{59}(CN)_6]_3$ Iron hexacyanoferrate-59(II)

$Fe_4[Fe(C^{14}N)_6]_3$ Iron hexacyano-C14-ferrate(II)

$Fe_4[Fe(CN^{14})_6]_3$ Iron hexacyano-N14-ferrate(II)

$Fe_4^{59}[Fe^{59}(C^{14}N^{14})_6]_3$

Iron-59 hexacyano-C14,N14-ferrate-59(II)

$[Cr_3^{52}(C_2H_3O_2)_6(OH^2)_2]Br$

Hexaacetatodihydroxo-2-trichromium-52(III) bromide

$[Cr_3^{52}(C_2H_3{}^2O_2)_6(OH)_2]Br$

Hexaacetato-2-dihydroxotrichromium-52(III) bromide

$[Cr_3(C_2H_3{}^2O_2)_6(OH^3)_2]Br$

Hexaacetato-2-dihydroxo-3-trichromium(III) bromide

These examples show applicability of the rule to somewhat more complex inorganic compounds, including some extreme cases involving a degree of substitution of special isotopes unlikely to be encountered.

Rule 4. *Partial substitution by a special isotope is indicated by application of the foregoing rules, inclusion of the appropriate symbol, and insertion of a suitable coefficient specifying the extent of substitution.*

In the case of dimethylgallium tetrahydroborate, for example, suppose that there is only a partial substitution of H^2 for ordinary hydrogen, *i.e.*

$$(CH_2H^2)_2Ga(BHH_3{}^2).$$

The appropriate name is: Dimethyl-1H2-gallium tetrahydroborate-3H2. Although this procedure becomes unwieldy when unduly extended, it may prove useful also as a scheme for the designation of percentage enrichment with respect to a particular isotope.

Rule 5. *Wherever it is necessary to specify both mass number and ionic charge, the symbol together with the mass number as a right superscript is enclosed in parentheses and followed by the usual charge designation.*

The necessity for this rule obviously follows from the practice implicit in Rule 2. The following cases are typical:

$(Sn^{113})^{++++}$
$(Sn^{113})^{+4}$
$(Sn^{113})^{IV}$ } Tin-113(IV) ion

$(U^{235}O_2)^{++}$ Uranium-235 dioxy(II) ion

$(S^{31})^{=}$ Sulfide-31 ion

$(BiO_3{}^{15})^{-}$ Bismuthate-15 ion

In this connection it is worthy of note that the ne for both Rule 2 and Rule 5 would be obviated American scientists would adopt the practice of wri ing the mass numbers as left superscripts.

Rule 6. *Metastable nuclear species are denot by appending the lower-case letter m to the ma number.*

This practice is merely an adaptation of that em ployed by Seaborg and Perlman (*Rev. mod. Phys.*, press). In the absence of the letter m, the grou state is, of course, implied. The following are typi cases:

$HgBr_2^{80m}$ Mercury(II) bromide-80m

$In_2^{115m}(SO_4)_3$ Indium-115m(III) sulfate

It is clearly evident that there will arise numero special cases which will require modification and extension of these proposals. Just as is true of sy tematic nomenclature uncomplicated by the proble of special isotopes, it is inevitable that situations n amenable to the application of any set of rules will encountered. In extreme cases, recourse must be h to the abandonment of names in favor of formula in some instances structural formulas may be requir for an unequivocal designation of the position of particular isotope. On the other hand, undue relian should not be placed upon either the use of elabora formulas or the possible clarification provided by t accompanying text. Tabulations and indexes shou be kept as free as possible from annoying explanato footnotes.

Finally, the writer wishes to acknowledge his i debtedness for numerous helpful suggestions and co ments from Drs. W. M. Manning (Argonne Nation Laboratory) and W. H. Sullivan (Naval Radiati Laboratory) and from Profs. T. H. Davies and W. Libby (University of Chicago), J. E. Willard and Larsen (University of Wisconsin), G. T. Seabo (University of California), L. O. Morgan (Univ sity of Texas), and others. From a collection of som times widely divergent views, an attempt has be made to evolve a scheme of isotope designation th is simple, of broad applicability, as free as possi from purely mechanical hazards in typing and ty setting, and in reasonable conformity with prevaili practices in systematic inorganic nomenclature. Co ments and suggestions will be appreciated.

TECHNICAL PAPERS

The Common Cold: Titration of MR-1 Virus[1] in Embryonated Eggs

LEON T. ATLAS and GEORGE A. HOTTLE[2]

Laboratory of Infectious Diseases, National Institutes of Health, Bethesda, Maryland

Research with viruses producing diseases only in human hosts has been handicapped by the lack of a laboratory method for demonstrating the presence and amount of virus. The onset of typical disease in human volunteers following experimental inoculation often has been the only manner of detecting the presence of virus (*9*). Studies at the National Institutes of Health have been in progress to devise methods other than human-volunteer inoculation for measuring the amounts of common cold viruses. Thus far, attempts to demonstrate MR-1 virus by the production of disease in available laboratory animals, by hemagglutination (*2, 9*), by inhibition of hemagglutination by other viruses, by serological tests, and by interference with the multiplication of other respiratory viruses (*2*), have not been successful. The investigation of infected and noninfected allantoic fluids from chick embryos has, however, revealed certain chemical differences.

The only two components common to all viruses thus far isolated are protein and nucleic acid (*5*). Preliminary study of absorption at 275 mμ in the Beckman spectrophotometer showed high protein peaks in dialyzed MR-1–infected allantoic fluids from 10- to 16-day-old fertile eggs.[3] Although dialyzed normal allantoic fluids had very little absorption until the 13th day, thereafter the values varied so much in individual eggs that some normal fluids exhibited higher protein peaks than the infected fluids. It was evident, therefore, that this test did not afford a specific quantitative index of infection.

After numerous trials with dialyzed fluids seeking the determination of nucleic acid components by carbazole (*4*), diphenylamine (*7*), cysteine-sulfuric acid (*8*), and tryptophane-perchloric acid procedures (*3*), the only method found to differentiate infected from normal fluids was a modified tryptophane-perchloric acid (TPA) procedure. As the data of Table 1 indicate, allantoic fluid pools containing virus (demonstrated by the production of colds in human volunteers) had positive values, usually above .010, with this procedure, whereas pools often from eggs receiving the same inoculum but not infectious for human volunteers gave 0 or minus results. Minus TPA values occur presumably because the allantoic fluids contain substances which inhibit formation of color by the reagents. Because of the variabilities and technical difficulties involved in dialysis, it was desirable to obtain a more satisfactory method of freeing fluids from interfering substances.

TABLE 1

COMPARISON OF TPA VALUES AND COLDS PRODUCED IN HUMAN VOLUNTEERS BY ALLANTOIC FLUID FROM MR-1 INOCULATED EGGS

MR-1 virus-inoculated fluid	TPA value*	Symptoms	Human volunteers Incidence (#colds/#inoc.)	Severity
EP7 (7/7/47)	0.049	Colds	21/21	4+
EP7 (8/28/47)	0.034	"	14/16	3+
EP7 (12/2/47) Ultracentrifuged concentrate 5×	0.140	"	14/14	3+
EP8 (1/29/48)	0.032	"	5/8	3+
EP9 (3/17/48) Pool A	0.016	"	7/8	3+
EP9 (3/17/48) Pool B	0.058	"	5/7	3+
EP9 (6/24/48) Individual fluids with TPA over 0.244 pooled	0.425	"	8/8	4+
EP9 (6/24/48) Individual fluids with TPA about 0.010 pooled	0.006	"	3/8	1+
EP9 (2/12/48)	−0.031	none	0/7	
EP9 (3/2/48) Pool A	−0.005	"	0/8	
EP9 (3/2/48) Pool X	0.002	"	0/8	
EP10 (4/16/48) Ultracentrifuged concentrate 10×	-0.004	"	0/8	

*Determined on dialyzed fluids by the color procedure described in the text.

An adequate procedure was developed. Allantoic fluids from 13-[4] or 16-day-old embryonated eggs are harvested after chilling at ±4° C overnight. Following the inoculation of thioglycolate medium for sterility tests, the fluids are frozen and stored at −50° C. Each sample of fluid is thawed at the time of test, and duplicate 1-ml portions at 1° C are mixed with 2 ml of cold (−50° C) methyl alcohol. After storage overnight at 1° C, the fluid is centrifuged (2,500 r.p.m.) for 20 min at 1° C. The precipitate is resuspended in 2 ml of distilled water and then mixed with 2 ml of M/5 calcium acetate solution.[5] Subsequent centrifugation (3,000 r.p.m.) for 20 min at 1° C sediments the precipitate used for the determination of the TPA value.

[1] MR-1 virus is the name given to the agent isolated and described by Topping and Atlas (*9*).

[2] We wish to acknowledge the valiant cooperation of over 400 adult male volunteers who have participated in these studies and the generous assistance of the Department of Corrections, District of Columbia, in making its facilities available for the human studies of the common cold.

[3] All dialyzed fluids reported were dialyzed against distilled water 4 days at +4° C with a minimum of 4 water changes/day.

[4] Fluids from 13-day-old eggs are preferred because they contain fewer interfering substances.

[5] The use of calcium acetate solution was suggested by Dr. Frederick Bell from unpublished data in experiments conducted by F. Bell, J. Wright, and K. Habel.

To the first (fluid control) of the two tubes from each sample of precipitated allantoic fluid is added 1.8 ml of distilled water plus 1.8 ml of 60% perchloric acid. To the second tube of each set is added 1.0 ml of distilled water, 0.8 ml of 0.375% *dl*-tryptophane, and 1.8 ml of 60% perchloric acid. After thorough mixing, the tubes are immersed in a boiling-water bath (95°–98° C) for 2 hrs. The tubes are cooled in tap water, and the optical density of each solution is determined in the Beckman spectrophotometer at 500-mμ wave length, using a 1-cm cell. For controls, two tubes containing distilled water in place of allantoic fluid (reagent controls)[6] and two tubes each containing 0.5 mg of desoxyribonucleic acid (DNA standards) are subjected to this procedure in each test. The TPA value is calculated by subtracting the reagent control reading plus the fluid control reading from the test reading.

By the use of the TPA method, infectious virus can be titrated in 6-day-old embryonated eggs. These are inoculated with each dilution of virus-containing material, incubated at 36° C, and harvested 7 days later. The TPA value of each allantoic fluid indicates whether or not the fluid contains virus. The infectious titer of a fluid, ID_{50}, is calculated (*6*) and indicates the dilution of virus which produces positive TPA values in half the inoculated eggs.

That positive TPA values demonstrate multiplication of the infectious agent is confirmed by the comparison of TPA values, titration in eggs, and colds produced in human volunteers by MR-1 virus-inoculated allantoic fluids (see Tables 2, 3). In the experiments shown in Table 3, individual fluids selected for negative TPA values from eggs inoculated with *undiluted* seed virus did not produce symptoms in human volunteers and showed no growth by titration in individual eggs. However, fluids with positive TPA values, even from eggs inoculated with dilutions up to 10^{-7} of the *same seed*, produced severe colds in human volunteers and titered in eggs up to $10^{-8.5}$.

TABLE 2

MR-1 virus-inoculated fluid					
Pool	TPA value	Titer in eggs	Human volunteers		
			Symptoms	Incidence	Severity
EP9 (7/7/48)	−.033	Untested	None	0/8	
EP8 (3/26/48)	−.030	"	"	0/8	
EP9 (4/6/48)	−.017	"	"	0/7	
EP11 (5/28/48)	.042	$>10^{-3}$	Colds	7/8	3+
EP11 (7/2/48)	.043	10^{-5}	Untested		
EP10 (8/30/48)	.205	Untested	Colds	8/8	4+

TABLE 3

Dilution of egg inoculation	MR-1 virus-inoculated fluid					
	Tested fluids	TPA Value	Titer in eggs	Human volunteers		
				Symptoms	Incidence	Severity
*10^{-3}	EP12C #27	−.012	Untested	None	0/4	
*Undil. to 10^{-1}	EP12C #8 and #20	.086	$>10^{-7}$	Untested		
†10^{-7}	EP13 #92 and #98	.055	Untested	Colds	2/8	2+
‡Undil.	EP12A #9 and #5	−.003	$<10^{-3}$	None	0/4	
‡Undil.	EP12A #1	−.005	"	"	0/4	
‡Undil.	EP12A #8	−.005	"	"	0/4	
‡10^{-3}	EP12A Pool Y	.060	$10^{-4.5}$	Colds	5/8	2+
‡1 : 2	EP12B Pool L	−.024	$<10^{-3}$	Untested		
‡Undil. to 10^{-3}	EP12B Pool H	.156	$10^{-6.5}$	"		
‡Undil. to 10^{-3}	EP12B Pool M	.011	$10^{-6.5}$	"		
§10^{-7}	EP13 #52 and #63	.069	Untested	Colds	8/8	4+

* Inoculum was EP11 (7/2/48).
† Inoculum was EP12C #8 and #20.
‡ Inoculum was EP11 (5/28/48) pool.
§ Inoculum was EP12B, Pool M.

Whether the substance responsible for the TPA value is a virus constituent or some by-product of infection in the fluid is being investigated. Since substances other than desoxyribonucleic acid (DNA) give color with the modified TPA procedure, positive values with this method do not necessarily represent DNA. Some evidence suggests that a virus constituent may be measured by the TPA value. The reacting substance may be present, however, before as well as after virus capable of multiplication can be demonstrated. Accordingly, for measurement of the actual MR-1 infectious capacity, titration in eggs utilizing the TPA procedure remains necessary.

[6] For reasons undetermined, the reagent controls may vary considerably from test to test.

udy of the manifold properties of MR-1 virus is ilitated by the TPA procedure. Under investigation e reisolation of this virus from nasal washings (*1*) olunteers with colds produced by egg passage MR-1 y human-to-human transfer of the disease. With the A procedure, it may be possible to isolate and study ts other than MR-1 virus, without the necessity of ious human volunteer studies.

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ctron Microfossils

H. M. BARTON and D. J. JONES

Phillips Petroleum Company, Bartlesville, Oklahoma

here are a number of areas, particularly in the Gulf st, where oil wells are drilled through thick sections shale having few or no individual and unique char-ristics as far as petrology and the usual paleontologi- markers are concerned. It is therefore often difficult locate the well in the geologic section, except very ghly, and this complicates correlations from one well nother. Electron microscopy was one of the several niques investigated in this laboratory in attempts to ferentiate between portions of these shales. It was ught that it might be possible to observe differences he microstructure of the shales, or that very minute rofossils might exist which would be sufficiently dis-t to serve as markers.

amples of cuttings were collected at the shale shakers everal wells, principally in the Chocolate Bayou field, roximately 30 miles south of Houston, Texas. Most these samples were from the Frio, a nonmarine Oligo- formation. This is a gray-green, fine-grained, mica-s shale containing a little bentonite. In one well, the illips Petroleum Company No. 1 Robnett, this forma-was encountered at 8,920′ and extends down past the sample taken at 12,583′. Samples in the range from roximately 10,000′ to 11,000′ were taken at three er wells in this field. Samples were taken also at two ls in Upshur County, Texas, about 230 miles north of Chocolate Bayou field. These were from the Eagle d formation, from the basal Upper Cretaceous. In dition, samples were examined from the Black Band le, an iron ore mined in eastern Ohio from the base of Conemaugh formation, of Pennsylvanian age. Thus, ee eras are represented altogether—Cenozoic, Mesozoic, d Paleozoic, in that order.

The material was crushed, and the portion that would pass a 200-mesh sieve was mixed with water in such proportions that the water was just cloudy, the actual amount being determined by experiment and later judged by eye. It was found that results were better if the suspensions were allowed to settle briefly so that the larger particles were removed.

A number of distinctive objects were found. It is difficult to determine anything about the origin of some of

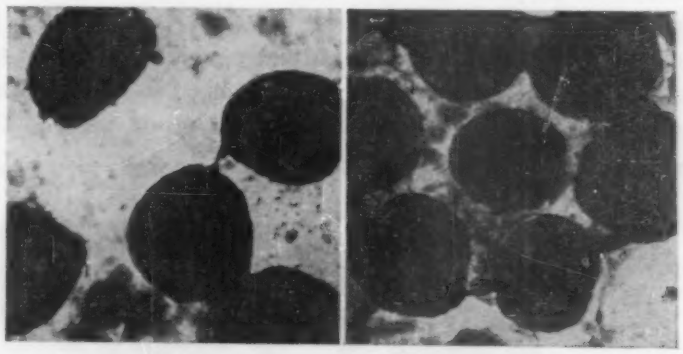

FIG. 1

FIG. 2

them—whether they are plant, animal or mineral. The pro em is complicated somewhat by the possibility of conta ination of the samples by drilling mud and by air-borne materials. Bacterial contamination is known to occur, but the usual air-borne bacteria are easily recognized, for the most part by their relative transmittance to the electron beam. Objects not opaque to the electron beam were not considered likely to be fossilized.

FIG. 3

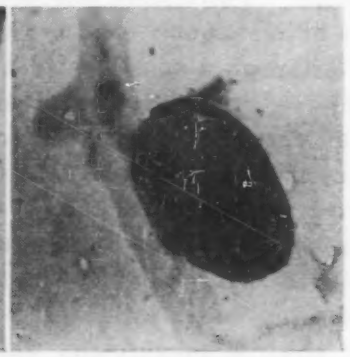

FIG. 4

Some objects were seen which may be fossilized spores of bacteria, algae, or fungi. These are somewhat discoid in shape, some having smooth edges, as shown in Fig. 1, and some having crenulated edges. The clue that these may be spores is strengthened somewhat by the finding of one group of discoids still fastened together by some sort of a membrane, although the membrane may possibly indicate contamination by contemporary organisms (Fig. 2). These discoids were found in most of the samples. They were so prevalent in all formations studied that they would not be suitable as marker types, unless it is found on further work that they have a definite geologic limit somewhere in the section. No evidence of such a limit was found, although investigation of older formations may indicate one. These discoids are somewhat similar to the spores of contemporary fungi such as *Penicillium notatum* and *Penicillium digitatum*, shown, respectively,

in Figs. 3 and 4. Knaysi, Baker, and Hillier (*1*) have described the endospores of *bacillus mycoides,* which show similarities to some of these fossils. Variations of the discoids include some having up to four perforations. We advance no hypotheses as to the nature of these objects. Possibly a mycologist may recognize them.

Besides the fairly numerous discoids, a number of other typical shapes were seen. A great many rod-like objects were observed, some of which were very probably minerals. Halloysite is known to have a rod-like crystal habit. The rods of halloysite observed by us have all had sharp edges, however, and many of those seen in the shales were rounded. They may actually be fossilized bacteria, but we cannot be certain. One of the rod-like types is shown in Fig. 5.

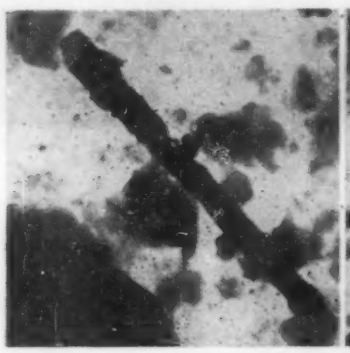

FIG. 5

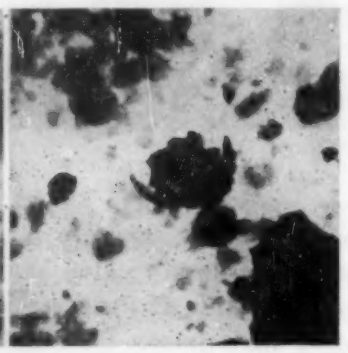

FIG. 6

A few other distinctive shapes are more rare. One of these is shown in Fig. 6. Several such shapes were found. There were also a few surprising shapes which we have seen only once as yet.

Although a considerable number of objects have been observed which may be microfossils, none has been found which was sufficiently characteristic of a particular formation or part of a formation to identify the formation from which it came. Not enough work has been done as yet to conclude that such markers do or do not exist. A great many samples must be examined and correlated from numerous localities in order to compile a catalog of electron microfossils which will be a useful tool in paleontology.

The technique must be examined critically at all stages, from the collection of the sample at the well to the final correlations. The ever-present possibility of contamination must not be overlooked. This contamination may come from the drilling mud or from careless handling of the samples after collection. The sample preparation, including the crushing and dispersion, should be standardized to allow workers in this field to exchange data on the same basis.

The work reported here is a small beginning on the problem. As in any new field, interest in the technique must at first be academic until enough data are amassed to make it useful. It does offer a possibility of making geologic correlations not now feasible.

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The Aerobee Sounding Rocket—A New Vehicle for Research in the Upper Atmosphere

J. A. VAN ALLEN, L. W. FRASER, and J. F. R. F

Applied Physics Laborato
The Johns Hopkins Univer

During the past two and a half years the captured G man V-2 rockets have found wide and fruitful applica as vehicles for the transport of research equipment the upper atmosphere (*3*). The firings of the V-2s been conducted by the U. S. Army Ordnance Depart at the White Sands Proving Ground near Las Cruces, Mexico.

From the beginning it was realized that the avail supply of V-2 rockets was limited and that the exp of duplicating them in this country for application s to research studies was probably prohibitive. Furt more, the complexity of the control equipment and o necessary accessories required a large technical group in preparation of the rockets for firing.

Early in 1946 the Applied Physics Laboratory of J Hopkins University initiated a program for the deve ment of a small, relatively inexpensive sounding ro to make possible exploratory as well as comprehen studies of phenomena in the upper atmosphere, far a balloon altitudes, on a continuing, long-term basis. S port of this development was undertaken by the N Bureau of Ordnance with the assistance of the Offic Naval Research.

The Aerojet Engineering Corporation and the Dou Aircraft Company have now successfully accompli this development under the technical direction of Laboratory. The immediate engineering basis for new rocket was provided by the work of the Jet P pulsion Laboratory of the California Institute of T nology in the development of the WAC Corporal (*2*). spite of the success of the WAC Corporal, its small p load and small useful volume severely limited its use ness as a research vehicle.

A schematic outline of the Aerobee, as presently b built, is shown in Fig. 1. The payload of instrum is contained in a thin, pressure tight, ogival nose con the forward end of the rocket.

The basic diameter of the rocket is 15″, and the o all length, 226″; the nose cone is 88″ in length. P pulsion is in two stages: a solid fuel booster brings velocity up to about 1,000′/sec, then falls away. sustaining motor continues to propel the missile for a 45 sec. At the end of the powered period, the velo of the rocket is about 4,100′/sec, and the altitude, a 95,000′ (as launched on a near-vertical trajecto Typical summit altitude is over 70 miles, with a us payload of 150 lbs of equipment. Payloads of 100-

[1] Operating under contract NOrd 7386 with the U. S. N Bureau of Ordnance.

an be carried with correspondingly greater or lesser imum velocities and summit altitudes. The Aerobee ains no guidance or control equipment. It possesses w stability by virtue of its three fixed tail fins and irtue of proper location of its center of mass. Con- of its trajectory is accomplished by tilting the long ') launching tower in accordance with wind data meteorological balloon runs. The applicable wind- theory has been developed by the Ballistic Research oratories of the Aberdeen Proving Ground and by this oratory.

ata which the instruments yield in flight are "cap- d" by two methods: (a) radio transmission from a pact 85-mc telemetering set developed by this Labora- , and (b) physical recovery from the impact wreck-

On April 13 a flight of similar summit altitude occurred. Measurements of the earth's magnetic field were accomplished by means of a total field magnetometer apparatus prepared jointly by the Naval Ordnance Laboratory, the Department of Terrestrial Magnetism of the Carnegie Institution, and this Laboratory.

A fourth live round was equipped by this Laboratory with a set of aerial reconnaissance cameras (and with two classified experiments) and fired on July 26. The flight was again normal, with peak altitude over 70 miles. A large number of high-quality aerial photographs of large areas of the earth's surface and of cloud formations in the lower atmosphere was obtained by physical recovery of the film. The potentialities of rockets for reconnaissance over inaccessible areas were again clearly demon-

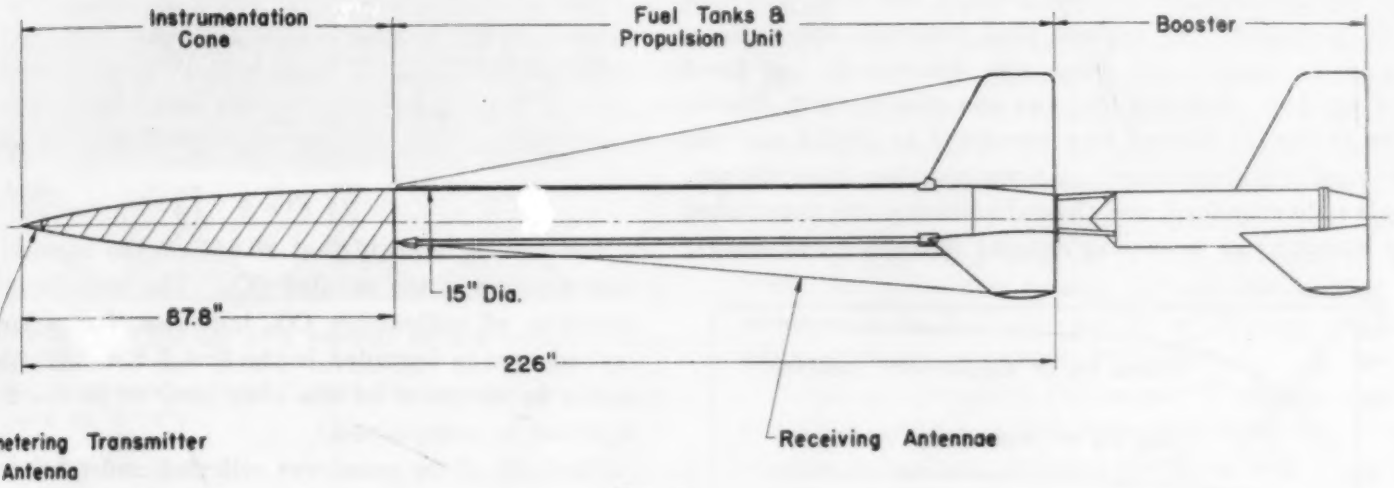

FIG. 1

A great improvement in the success of physical wery is provided by explosive separation of the tail- tructure from the remainder of the rocket at a suit- altitude on the descending branch of the trajectory. tailless missile is aerodynamically unstable and bles to earth with a velocity in the order of 150′/sec. act shock is thus greatly reduced; for example, photo- phic film contained in heavy-walled metal casettes is vered intact.

irings of the Aerobee are conducted by the U. S. al Unit at the White Sands Proving Ground. The sical Science Laboratory of the New Mexico College Agriculture and Mechanic Arts provides essential as- ance in the operation of telemetering equipment, in r field work, and in the reduction of data.

ollowing preliminary firings of three dummy missiles, aining no sustaining motor, the first live Aerobee was on November 24, 1947. Due to an excessive initial , it was necessary to terminate the thrust of the motor radio command at 35 sec flight time in order to avoid act outside of the military range. The resulting sum- altitude was, therefore, only 190,000′. The second firing was on March 5, 1948 and was thoroughly suc- ful. Equipment for measuring the directional inten- and angular distribution of cosmic rays above the reciable atmosphere was transported to 372,000′ and ded valuable new data (*1*).

strated. Detailed information on the angular motion of the missile was obtained.

A series of further experiments is being prepared by this Laboratory for the coming year.

The Naval Research Laboratory, under its sponsor, the Office of Naval Research, is receiving 5 of the original order of 20 Aerobees and has conducted one set of experiments in a flight of August 5.

The simplicity of the rocket and its relative inexpensiveness (as compared to the elaborate V-2) will, it is believed, make possible a wide variety of investigations in the physics of the upper atmosphere. Comprehensive studies of high-altitude phenomena at different seasons of the year, at different times of the day, at different latitudes and longitudes, etc. are now within the range of feasibility.

Detailed reports on diverse aspects of the Aerobee program and reports on results of individual experiments are under preparation by various authors and will be submitted to appropriate journals.

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Metabolism of C^{14}-labeled Urea[1]

EDGAR LEIFER, LLOYD J. ROTH, and
LOUIS H. HEMPELMANN

Los Alamos Scientific Laboratory of the University of California, Los Alamos, New Mexico

The work of Bloch (*1*) using N^{15}-labeled urea indicated that a small portion of the nitrogen of ingested urea was transformed to ammonia and protein N, while the majority of the labeled urea was excreted as such. To determine the fate of the carbon in the urea molecule, C^{14}-labeled urea was synthesized (*3*), and the gross metabolism was studied in a series of mice using the method described by Roth, Leifer, Hogness, and Langham (*4*).

Five-tenths mg of C^{14}-labeled urea equivalent to 60,000 cps/mg was injected intraperitoneally into each of 9 mice (CF-1 strain). At various time intervals the radioactivity in samples of urine was determined by direct plating (*2*). Exhaled CO_2 was absorbed in 20% NaOH. The carbonate formed was converted to $BaCO_3$ and the radioactivity determined. At various time intervals animals were sacrificed, and the radioactivity was determined by burning and measuring activity in the form of $BaCO_3$.

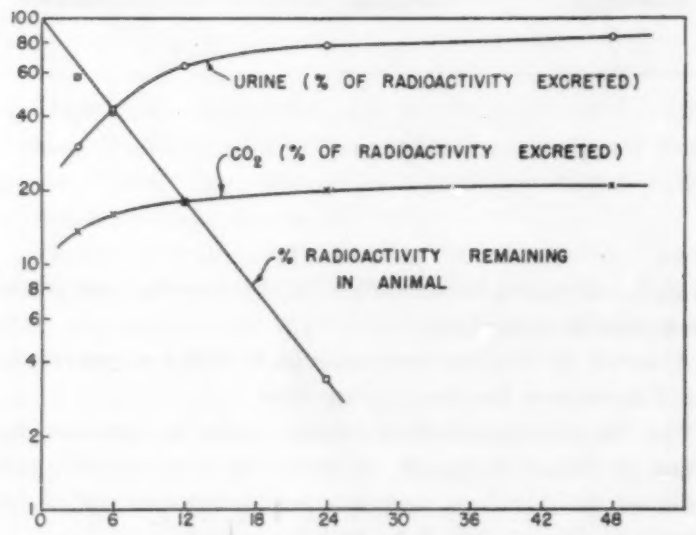

FIG. 1

The per cent of radioactivity excreted in the urine and in the exhaled CO_2 as a function of time is shown in Fig. 1. At 48 hrs one can see from this figure that the sum of activities in urine and CO_2 add up to 105%. This can be explained by an error involved in the measurement of the initial injection volume. Subtracting the excreted amounts from the initial amount injected, the per cent of radioactivity remaining in the animals at various times after injection was calculated. The results are presented graphically in Fig. 1. From the graph the biological half-life of urea was found to be 5 hrs.

The urine was analyzed using the method of filter paper chromatography with the following developing solvents: (a) butanol-water, (b) butanol-3% NH_4OH, (c) butanol-ethanol-water, (d) hexanol-water, (e) hexanol-ethanol-water, (f) phenol-water, (g) phenol-NH_4OH (3%), s-collidine-water. Radioautographs of the paper st were then made on No Screen or Blue Brand X-ray in order to identify radioactive metabolites.

Fig. 2 shows a typical radioautograph obtained f solvent systems and established the fact that the ra active carbon in the urine is contained only in the u

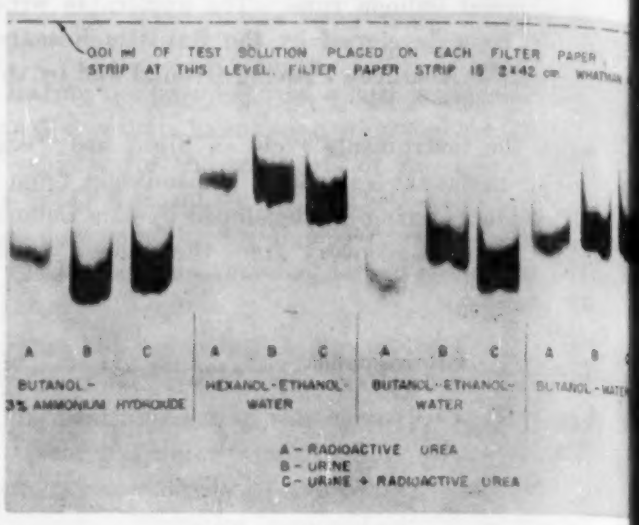
.001 ml OF TEST SOLUTION PLACED ON EACH FILTER PAPER STRIP AT THIS LEVEL. FILTER PAPER STRIP IS 2×42 cm WHATMAN
A B C
BUTANOL - 3% AMMONIUM HYDROXIDE
A B C
HEXANOL - ETHANOL - WATER
A B C
BUTANOL - ETHANOL - WATER
A - RADIOACTIVE UREA
B - URINE
C - URINE + RADIOACTIVE UREA

FIG. 2

The results indicate that 20.8% of the injected C urea appears in the exhaled CO_2. The very rapid in excretion of radioactive CO_2 indicates that a large cent of urea is degraded in the first 3 hrs. Whether is due to elevation of the urea level or to the mod injection is unexplained.

The bulk of the urine was collected under toluene, to ascertain that the CO_2 collected was not due to terial decomposition of the small fraction of urine on side of the cage, the caudal halves of 2 mice injected C^{14} urea were isolated in airtight sheaths and the exh CO_2 collected. The CO_2 collected during the first 20 after injection was found to contain radioactive carbo the same amounts as in the previous experiment.

Tissue analyses indicate that the injected C^{14} ure uniformly distributed on a weight basis within 25% the liver, spleen, heart, muscle, brain, and blood, as mi be expected, since urea is freely diffusible. The kidn however, contained two to three times the amount radioactivity of the other tissues tested, presumably cause of the concentrating action of the tubules.

The mechanism of the formation of CO_2 has not b established. Whether this goes by reversal of the Kr urea cycle or through another mechanism, such as di hydrolysis, remains to be established.[2]

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[1] This document is based on work performed under Contract No. W-7405-eng-36 for the Atomic Energy Commission.

[2] Since this paper was submitted for publication, sim results using C^{14}-labeled urea have been obtained at Southern Research Institute, Birmingham, Alabama (sonal communication, Dr. Howard E. Skipper).

A Plastic Plate for Use in Tests Involving Virus Hemagglutination and Other Similar Reactions[1]

JONAS E. SALK[2]

Virus Research Laboratory & Department of Bacteriology, School of Medicine, University of Pittsburgh

The purpose of this communication is to describe a plastic plate[3] that may be used as a substitute for the test tubes and racks needed in titrations of influenza virus hemagglutinin and the agglutination-inhibition antibody (*1*). Through simplification of the technical aspect of the work, chiefly by obviating the washing of tubes and setting up of racks, the use of the plate has facilitated greatly the conduct of large numbers of titrations simultaneously and has provided certain other advantages.

The plate is made from a block of clear Lucite, 7″ × 9″ × ½″, into which 80 shallow cavities have been drilled in 10 rows of 8 each; space between rows in each direction measures $\frac{9}{16}$″. The hollows are ¾″ in diameter, have a maximum depth of $\frac{7}{16}$″, and can hold approxi-

FIG. 1. Diagram of a vertical section made through the apex of the drilled cavities in the plastic plate. The thickness of 1/2″ Lucite blocks may vary by as much as 1/16″.

mately 2½ cc of fluid. As shown in Fig. 1, the wall of the cavity is vertical and the bottom is conical rather than hemispherical (as is the bottom of a test tube). The inclined sides of the cone allow the unaltered cells to slide toward the apex and, at the same time, provide a large surface of gentle slope to which the "agglutinated" cells adhere as they settle out of suspension. The characteristic patterns of the sedimented cells in positive and negative reactions are the same as those seen in test tubes (*6*), but end-points of titrations, somewhat sharper.

Because of the larger surface the settled cells are required to cover in the depressions of the plastic plate, a greater number of red cells are required as compared with the concentration employed in tests done in small test tubes. In a previous report (*6*) of a procedure for titrating influenza virus hemagglutinin, a final concentration of 0.125% of chicken red blood cells in a 1-cc mixture was recommended in tests performed in 10 × 75-mm tubes. However, for tests done in the plastic plate twice this quantity of cells is necessary.

After the various reactants are mixed together, each plate is shaken effectively, but carefully, and set aside to be read after the cells have settled. Although the test may be read in 45 min, an hour has been selected arbitrarily as the time for recording the results. The plates are viewed from the top, preferably against a white background. Criteria for positive and negative reactions are the same as illustrated elsewhere (*6*).

As for the temperature at which the cells are allowed to settle, it has been found that equally satisfactory results are obtained in tests done at 4° C and 30° C, provided the readings are made within the prescribed time. The wide, shallow depressions permit rapid settling of the red cells; this appears largely to eliminate the variations attributable to temperature (*6*) and noted particularly in tests done in small test tubes. Absence of significant temperature effect is of considerable value in summer.

These plates have been found particularly useful in performing the agglutination-inhibition tests. The procedures followed involve the use either of a constant dilution of virus and serial dilutions of serum (*1, 2, 6, 8*) or of a constant dilution of serum and serial dilutions of virus (*5, 7*). In the presence of serum the cells settle more rapidly and the test should be read in 30–45 min.

In the performance of the agglutination-inhibition test, and also for virus titrations, frequent use is made of the spring-plunger type automatic syringe (from the B-D Cornwall pipetting unit) as a substitute for a pipette. When the automatic syringe is used for making serial dilutions, it is fitted with an 18- or 19-gauge needle that has a shaft approximately ¼″ long.

Plates are prepared for re-use by rinsing them well under tap water and then immersing them in a detergent solution or in *dilute* cleaning solution (10% sulfuric acid containing 0.5% potassium dichromate). In the routine procedure followed at present the plates are submerged in dilute dichromate-sulfuric acid solution for about 2–3 min, rinsed liberally under running tap water, and then rinsed in 3 successive pans of distilled water. Excess moisture is shaken off by brisk tapping against the hand, the plates then being allowed to dry either in the air or in front of a fan. The acid-dichromate solution recommended above appears not to be injurious to Lucite. Immersion for several hours produced no visible change, although a short period in more concentrated acid-dichromate changes the clear, smooth surface of the Lucite into an opaque, granular surface.

The plate described was drilled by machine at a cost that is not prohibitive. This could be reduced considerably, however, by using a mold prepared in the desired form. The applicability of this or similarly designed devices to other problems of a related nature is evident.

[1] This investigation was conducted under the auspices of the Commission on Influenza, Army Epidemiological Board, U. S. Army, Office of the Surgeon General, Washington, D. C.

[2] The author wishes to acknowledge the helpfulness of Robert L. Laurent in the preparation of the plates.

[3] Nartsisov (*4*) and Mulder (*3*) have suggested somewhat similar, but less convenient, devices for the same purpose.

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Book Reviews

Pathology of tumours. R. A. Willis. London, Engl.: Butterworth; St. Louis, Mo.: C. V. Mosby, 1948. Pp. xxiii + 1044. (Illustrated.) $20.00.

This comprehensive textbook on neoplasms is written with clarity and authority, obviously backed by a wealth of practical experience. Many of the conclusions deviate from time-honored and commonly accepted views, but this departure from a simple compilation of opinions is a refreshing feature. Most of the illustrations are to the point and well chosen; the bibliographic references at the end of each chapter cover the field well. Printing of certain references in boldface, indicating the author's preferences, will doubtless lead the student to consult these first. The sections on the comparative pathology of most of the tumors contribute to a fuller understanding of the general subject.

Part I, an excellent review of the general aspects of tumors and experimental carcinogenesis, is augmented by the author's personal opinions on controversial points. It is brilliantly written, clear, and comprehensive. It might have been advantageous to enlarge on this part of the work, making it an independent volume, for some of the chapters in Part II on special tumors are weak—no doubt because of overcondensation. The value of these chapters would certainly have been enhanced for the advanced pathologist if Dr. Willis had drawn more extensively on his own experience to give a detailed treatment of such difficult diagnostic problems as "sclerosing adenomatosis" of the breast and "dermo-epidermal nevi," with particular reference to evaluation of their malignant potentialities.

In discussing bronchial and gastric cancers, the author takes a rather defeatist attitude toward the relevancy of histologic differentiation of these neoplasms. Might it not be possible that sophisticated histologic studies would reveal significant statistical differences in the behavior of tumors of different types which would have practical application in surgical evaluation? Willis argues to advantage in support of his opinions on controversial subjects such as the origin of the cartilage-like matrix of mixed tumors and the transformation of normal into tumor cells. It must be remembered, however, that concepts change from time to time and will remain labile until definite solutions are offered.

Many clinical pathologists will regret the lack of any reference to "desquamative cytology" as a diagnostic method, because at present it is so widely used in handling patients with suspected cancer.

The textbook unfortunately shares the fate of others in being somewhat outdated even at the time of publication. The chapter on testicular tumors, for instance, would have profited by the inclusion of material gained from the recent wide experience of the medical service of the U. S. Armed Forces.

Disagreement with the author in certain respects by no means constitutes disparagement of this excellent and valuable text on tumors; it might even stimulate efforts to prove or disprove certain points Dr. Willis proposes. *The pathology of tumours* will, in all probability, become the favorite reference on tumors for the experienced pathologist and the faithful guide for the student.

HANS F. SMETANA

Army Institute of Pathology, Washington, D. C.

Underwater explosions. Robert H. Cole. Princeton, N. J. : Princeton Univ. Press, 1948. Pp. ix + 437. (Illustrated.) $7.50.

This book grew from the wartime work of the author and others in the field of underwater explosions. Thus, it represents an effort to present publicly, to the limit permitted by secrecy restrictions still in effect, the substantial progress made in understanding this field experimentally and theoretically. The bibliography of 148 items consists largely of World War II reports.

The material is organized and presented from the physicist's point of view. Chemistry and other topics associated with the explosive itself are disposed of in four pages. Similarly, the engineering questions so important in military applications, such as the effect of explosions on nearby structures, are mentioned only in passing. The dominant theme throughout is the underwater explosion as a phenomenon of physics. Underwater acoustics, for instance, is treated only to the extent that it furnishes a first approximation to the explosion.

The chapters fall rather clearly into three groups. The first four chapters present basic information and theory concerning underwater explosions; then come two on experimental techniques; and the last four contain a detailed comparative discussion of experiment and theory.

To scientists, and particularly to engineers, directly concerned with underwater explosions, this volume should be very valuable as a summary of recent work and as an introduction and guide to the original reports. In addition, a large circle of readers in related fields will find it of great interest. For example, the detailed theoretical consideration of the shock wave in water is a rich source of stimulating analogies and suggestions to aerodynamicists concerned with the shock phenomenon in air flow.

Perhaps the widest appeal is carried by the chapters on experimental work: Chapter 5 on measurement of underwater explosion pressures and Chapter 6 on photography of the explosions. Any experimentalist will find here some diverting and instructive reading such as the reference (p. 218) to obtaining a time delay of 4.0 microseconds with a 1″ path difference in primacord fuse.

The editing and production of the book are excellent.

JOHN D. TRIMMER

University of Tennessee

NEWS and Notes

Ezra J. Kraus, chairman of the Department of Botany, University of Chicago, from 1934 to 1947, retired with emeritus status on December 20. Dr. Kraus, also a former editor of the *Botanical Gazette*, was selected by American horticulturists as one of the three greatest contributors to horticulture over the past century. He will make his home in Corvallis, Oregon, where he will teach advanced and beginning horticulture at Oregon State College and continue his research on chrysanthemums.

Paul F. Fenton, research assistant in nutrition at the Yale University School of Medicine for the past three years, during which time he has developed a program of study dealing with the nutrition of mice in connection with cancer research, will transfer his work to Brown University on July 1 and become an associate professor in the Biology Department.

Kenneth E. Caster, assistant professor of geology and fellow in the University of Cincinnati's Graduate School of Arts and Sciences, recently returned to the Cincinnati campus after almost four years in South America under the auspices of the State Department and the Guggenheim Foundation. While there he traveled tens of thousands of miles gathering geologic data, much of which bears on the theory of "continental drift." This, according to Dr. Caster, is a "completely open issue which can't be settled with the information now at hand."

Tibor Radó, internationally known theoretical mathematician, who is chairman of the Department of Mathematics at Ohio State University, is the first appointee to Ohio State's newly created "University Research Professorships." In his new position Dr. Radó will be responsible to the dean of the Graduate School and continue scholarly creative work in his field.

Dallas B. Phemister, professor and chairman emeritus of the Department of Surgery, University of Chicago, will deliver the 13th Christian Fenger Lecture of the Institute of Medicine of Chicago and the Chicago Pathological Society on Monday evening, January 10, at the Palmer House. His subject will be "Circulatory Disturbances of the Skeletal System."

Allen W. Goodspeed, professor of forestry at Iowa State College, has resigned as of January 31 to become professor of forest management at West Virginia University, Morgantown.

Carl F. Schmidt, professor of pharmacology at the University of Pennsylvania School of Medicine, will deliver the fourth Harvey Lecture of the current series at the New York Academy of Medicine on January 20. Dr. Schmidt's topic will be "Quantitative Measurement of Cerebral Blood Flow in Man."

Cledo Brunetti, former chief of the Engineering Electronics Section, National Bureau of Standards, will become associate director of Stanford Research Institute on January 1. Dr. Brunetti, cited in 1941 as America's outstanding young electrical engineer, participated in developing the wartime radar-guided bomb and the radio-proximity fuse, as well as the two-way wrist radio.

H. B. Mann has been named president as well as a director of the American Potash Institute, effective January 1, when John W. Turrentine, head of the Institute since its founding in 1935, retires. Dr. Mann has been affiliated with the Institute since 1936.

William W. Greulich, professor of anatomy at Stanford University, who has just returned from Japan, reports that Japanese youngsters who survived the Nagasaki atomic bomb are in much better condition this year than they were last year. Dr. Greulich attributes this change largely to improvement in the Japanese food supply and states that it is a characteristic shared by the rest of the Japanese population. Dr. Greulich, assisted by Mrs. Greulich in this long-range survey, examined 800 children of grammar and junior high school age during the past three months.

Linus Pauling, chairman of the Division of Chemistry and Chemical Engineering at CalTech, has returned from a brief visit to France. Dr. Pauling was one of four scientists to receive the degree of Honorary Doctor at the University of Paris. Others so honored were Arne Tiselius (Sweden), Sir Jack Drummond (England), and E. Briner (Switzerland).

Awards

The Institut International des Sciences Théoriques, 221, Avenue de Tervueren, Brussels, announces the Eddington Prize of 50,000 Belgian francs for the best exposition and critique of the conceptions of Eddington concerning the philosophy of physical science. Memoirs should be sent to the secretariat of the Institut before December 31, 1950.

The Sir William Schlich Memorial Medal was conferred on Herman H. Chapman, professor emeritus of forest management at Yale University and past president of the Society of American Foresters, on December 17 during the Society's annual meeting in Boston. The medal, awarded from time to time for noteworthy achievement in the advancement of forestry, is made possible through a fund established 15 years ago by foresters of English-speaking nations in recognition of Sir William's services to forestry in India, England, and throughout the world.

Fellowships

The Research Laboratories Division of General Motors Corporation has established a graduate fellowship in mechanical engineering for an outstanding student in the Wayne University College of Engineering. Its stipend will vary from $1,700 to $2,300 per year. Selections will be made jointly by the chairman of the Department of Mechanical Engineering and representatives of the donors.

Radcliffe College, Cambridge, Massachusetts, has announced that application blanks for the Helen Putnam Fellowship for Advanced Research

may now be obtained from the Secretary of the Graduate School. These should be completed and returned not later than April 1. This fellowship, which carries a stipend of $2,600 a year, with possibility of renewal, is open to postdoctoral fellows in the field of genetics or of mental health broadly defined to include such fields as clinical psychology and child development.

Several Graduate Teaching Fellowships in Chemistry are available for women at Smith College for 1949–50. These fellowships, which pay $800 plus tuition and fees for the first year and are renewable for a second year, with an increase of $100, are designed to enable students to obtain the Master's degree in two years, assisting in the laboratory and in other ways part time.

Trustee Fellowships which furnish both tuition and residence, thus enabling superior students to obtain the Master's degree in one year, are also available.

Inquiries should be addressed to Jessie Y. Cann, Chairman, Department of Chemistry, Smith College, Northampton, Massachusetts.

Colleges and Universities

Massachusetts Institute of Technology has just announced that an increase in tuition of $100 per academic year will be put into effect with the opening of the 1949 fall term. This increase, which will bring the Institute's comprehensive tuition, including all fees, to $800 per academic year, will be accompanied by a 30% increase in scholarship aid and by further liberalization of student loans, according to President James Killian, Jr. Loans up to a total of $250,000 a year can be made from the Institute's revolving Loan Fund, the largest in any American college.

A course on radiation therapy is now being conducted by Samuel J. Crowe, head of the Department of Otolaryngology, Johns Hopkins University, at the USAF School of Aviation Medicine, Randolph Field, Texas. Emphasis is placed on special problems in tonsil and adenoid tissue with reference to medical measures necessary for prevention of aero-otitis-media in flying personnel. During the course a survey of basic trainee airmen will be made under the supervision of Dr. Crowe and his associates, Le Roy Polvogt, of Johns Hopkins, and Ernie Weymuller, of the New York Eye, Ear, Nose, and Throat Hospital.

CalTech's new 200-inch Hale telescope at the Palomar Observatory may not be in operation until next fall, according to a recent announcement by Ira S. Bowen, director of the Observatory. Since late December 1947, when the first test photographs were made with the instrument, Dr. Bowen and his staff have been locating and eradicating "bugs" in the intricate mechanism. He pointed out that such delays are not unusual, for only after 10 years was the Mt. Wilson telescope found to be thoroughly satisfactory at all times.

Latest difficulty to be surmounted in the Hale telescope is a bulge, 20 millionths of an inch too high along the outer edge of the mirror, discovered while the mirror was under final test in the optical shop. Subsequent tests under actual operating conditions revealed that this condition was corrected to some extent but not sufficiently to assure the needed accuracy. Upon additional tests of the mirror and its support system, it was found that the mirror was not adjusting uniformly to temperature changes. Actually, the outside edge of the mirror adjusted itself to temperature changes more rapidly than the central portion. As a result, the edge was turned up by different amounts, depending on the temperature to which the mirror had been subjected in the preceding 24 hours.

To eradicate this newest "bug," Dr. Bowen and his associates have several solutions. They will first attempt to equalize the air temperature beneath the mirror and inside the mounting-point sockets with air about the outside edge. To do this a system of small fans may be installed inside the cell holding the mirror in order to circulate inside air sufficiently to provide an equalized temperature change. If, however, air circulation or insulation of the outer edge, or a combination of these does not provide the solution, it will probably be necessary to remove some glass to a depth of a few millionths of an inch from a portion of the mirror 18" wide along the outer rim. According to Dr. Bowen, at least 6 months will be needed for this polishing work at the Observatory. This work can proceed concurrently with installation of such major equipment for the telescope as the last 36" Coudé focus mirror, 7 smaller mirrors, and a Coudé spectrograph, and completion of two of three Ross correcting lenses.

Meetings and Elections

The 1949 convention of the Institute of Radio Engineers will be held March 7–10 at the Hotel Commodore and Grand Central Palace, New York City. The theme of the program will be "Radio-Electronics—Servant of Mankind." The technical sessions will cover not only radio, in its limited sense, but the entire field of electronics, including studies of nuclear energy. Among the events scheduled are a luncheon in honor of the incoming president, Stuart L. Bailey, and the annual banquet, at which 31 members who have recently become fellows of the Institute will be honored. Karl Spangenberg, of the Office of Naval Research and Stanford University, will deliver a speech of acceptance in their behalf. Nearly 200 exhibits of postwar developments and products will be displayed, many of them for the first time. One center will be devoted entirely to nuclear instrumentation.

The American Physical Society's Division of Solid State Physics will hold its annual meeting March 10–12, 1949, in Cleveland. A. W. Lawson, secretary, has announced that members should make reservations at the Hollenden Hotel in Cleveland not later than March 1.

Plans for the International Botanical Congress to be held in Stockholm in July 1950 are already getting under way under the chairmanship of Carl Skottsberg, of Gothenburg. It is expected that approximately 2,000 botanists from all over the world will

nd. Prior to the Congress ex-sion groups will have an oppor-ity to study the vegetation of thern and central Sweden and of ain islands in the Baltic Sea; rward, there will be tours to north-Sweden.

The American Mathematical So-y of the Southern California Area d its annual meeting November 27 the University of California, Los es. Approximately 10 members nded, and a total of 30 papers was ented. One o. the features of program was an invited address, he Geometry of Finsler Spaces,'' Herbert Busemann, of the Univer-of Southern California.

At a meeting of the Geological ciety of Washington held at the mos Club on December 8 James ele Williams, U. S. Geological Sur-, was elected president; Earl Inger-and E. T. McKnight, vice-presi-ts; Ralph E. Van Alstyne, secre-y; and Mrs. Charlotte M. Warshaw, asurer.

At this meeting the address of the ring president, W. W. Rubey, was en on ''The Problem of Changes Composition of Seawater and At-sphere During the Geologic Past.''

The Hawaiian Academy of Science d its 24th annual meeting Novem-18–19 at the University of Hawaii. e society holds two sessions each r, closing with a general business ting, election of officers, and an-l dinner at the end of the spring ting.

Papers presented during the two-session in November included ''A ide to Publications About the cific Area,'' by E. H. Bryan, Jr., nolulu author and bibliographer; On the Use of the Wechsler-Bellevue le in the Territory of Hawaii,'' len E. Peixotto, University of waii Psychological and Psycho-hic Clinic; ''Application of Meth-s in Human Genetics to the Study Mental Traits, With Special Ref-nce to Mental Defect,'' Sidney L. lperin, University of Hawaii Psy-logical and Psychopathic Clinic; The Naulu: A Distinctive Rainstorm pe,'' Luna B. Leopold, Department Meteorology, Pineapple Research Institute of Hawaii; ''Rainfall Distribution in Hawaii,'' C. K. Stidd, U. S. Weather Bureau, Honolulu; ''Rorschach Records Obtained Before and After Brief Psychotherapy,'' Edith E. Lord, University of Hawaii Psychological and Psychopathic Clinic; ''Oceanographic Developments in the Hawaiian Area,'' Robert W. Hiatt, Department of Zoology and Entomology, University of Hawaii; ''The Application and Mechanical Recovery of Internal Metal Fish Tags,'' Albert L. Tester, University of Hawaii; ''An Improved Micro-Method for Determination of Reducing Sugars,'' Dr. George Burr, Department of Physiology and Biochemistry, and T. Tanimoto, Hawaiian Sugar Planters' Association; ''The Action of Crustacean Eyestalk Hormones on Tissue Respiration,'' Bradley T. Scheer, University of Hawaii; and ''The Effect of Growth Hormone on Flowering in Grasses,'' Carl Leopold, Hawaiian Pineapple Company, Ltd.

The American Society of Zoologists, at its recent annual meeting in Washington, elected the following officers for 1949: Robert Chambers, New York University, president; Douglas M. Whitaker, Stanford University, vice-president; Walter N. Hess, Hamilton College, secretary; Frank A. Brown, Jr., Northwestern University, treasurer; and Carl G. Hartman, Ortho Research Foundation, member of the Executive Committee.

"A Hundred Years of Organized Science" was the theme of a meeting of the University Club of Winter Park, Florida, held November 30. The meeting had been arranged by the local committee of AAAS members, appointed in connection with the Centennial Membership Campaign. William E. Stark, secretary of the Club, writes:

''About 100 members of the Club were present. An interesting feature was the presence of the oldest member of the Club, Dr. Herbert Osborn, age 92, who has been a member of the AAAS for 65 years. Prof. Oliver P. Medsger gave an interesting story of the history of the Association including a tribute to some of the influential leaders of the earlier years. Dr. Paul A. Vestal gave us a report of the various symposia at the Centennial meeting. These talks were followed by questions and discussion, and I used the last 10 minutes to emphasize the value of membership in the Association to men who have only a superficial knowledge of science but are keenly interested in it and like to know what is going on in the scientific world. I spoke especially of my own enjoyment of *The Scientific Monthly*. . . .''

NRC News

The Joint SSRC–NRC Fellowship Program will be continued for the academic year 1949–50. It is the purpose of these fellowships to give special training to young men and women who have demonstrated marked ability in the natural sciences and who wish to undertake a broad program of study in the social sciences or, conversely, to those who are proficient in the social sciences and who wish supplementary training in one of the natural sciences.

Applicants for these Joint Fellowships, which are open only to citizens of the United States, must have training equivalent to that represented by the Ph.D. degree and must have demonstrated unusual talent for research and investigation.

Fellowships will be awarded by the Joint Fellowship Board in the Natural and Social Sciences in March 1949. To receive consideration at this meeting, applications must be filed on or before *February 1,* 1949. Unless otherwise arranged, tenure will begin on July 1, 1949.

Deaths

H. J. van der Bijl, 61, South African scientist, mathematician, and industrialist, died December 2 in Johannesburg. As a research physicist for the American Telephone and Telegraph Company and Western Electric Company from 1913 to 1920, Dr. Van der Bijl achieved recognition for his work in the development of radiotelephony.

William Gaertner, 84, founder and president of the Gaertner Scientific Corporation, Chicago, designers of scientific instruments, died December 3 at his home in Wilmette, Illinois.

Benjamin J. Slater, 60, associate medical director of Eastman Kodak Company and a leader in the field of industrial medicine, died December 4 in his Rochester, New York, home.

W. J. Dann, 44, British-born authority on vitamins and nutrition and professor of nutrition at Duke University School of Medicine, died December 5 at his Durham, North Carolina, home.

A. Wheeler Ralston, 48, assistant director of research of the Chemical Research and Development Department, Armour and Company, and author of the recently-published *Fatty acids and their derivatives,* died suddenly December 5 in Chicago.

George W. Barber, 58, entomologist at the New Jersey Agricultural Experiment Station and former research entomologist with the U. S. Department of Agriculture, died December 6 in New Brunswick, New Jersey. Dr. Barber was nationally known for developing control measures for insect pests of corn.

Marjory Stephenson, 63, a leading British authority on the cause of bacterial diseases and one of the first women admitted into the fellowship of the Royal Society, died December 12 in Cambridge, England.

At the Third Session of the General Conference of UNESCO, held in Beirut November 17–December 10, Jaime Torres Bodet, Minister of Foreign Relations of Mexico, was elected Director-General of that organization for a term of 6 years. In this post he succeeds Julian Huxley, internationally known British scientist, who has headed UNESCO since its organization in 1945. This week's cover shows Dr. Bodet addressing the final session of the Conference.

George V. Allen, Assistant Secretary of State for Public Affairs and chairman of the U. S. delegation, in advising the State Department of Sr. Bodet's nomination, stated:

"The election of Jaime Torres Bodet is an event of profound satisfaction to the United States Delegation and the United States Government. It is a tribute to his country, as well as to him. He won the gratitude of his countrymen and international recognition by his outstanding services as Minister of Education when he provided the leadership for a fundamental education program which has few parallels. His achievements since as Foreign Minister have won the respect and friendship of all nations seeking closer relationships and better understanding. His capabilities as an administrator and his intellectual leadership, together with his deep devotion to a peoples' movement should be invaluable to UNESCO and contribute immensely to the achievement of its goals."

A diorama containing a model of part of the ancient Maya city, Chichen Itza, and its surrounding landscape in Yucatan, Mexico, as it appeared at the height of its activity, about 1,000 A.D., has been installed in the Hall of American Archaeology at the Chicago Natural History Museum. According to Alexander Spoehr, who conceived and supervised preparation of the exhibit, the Maya Indians attained the highest degree of civilization of any aboriginal groups in North America. The exhibit has been created by Alfred Lee Rowell, dioramist, and John Pletinck. The latter is responsible for the temple restoration showing the elaborate architecture developed in plastered stone masonry by the Mayas. Mr. Pletinck visited the site of Chichen Itza to obtain data for guidance in its construction.

Several volumes in the National Nuclear Energy Series have been declassified and are in the final stages of preparation for publication, according to an announcement by the U. S. Atomic Energy Commission. The Series, which is expected to run to about 60 volumes upon completion, is being published by the McGraw-Hill Book Company, under a contract with Columbia University, which represents the AEC and its contractors. The volumes have been grouped in 8 Divisions, corresponding to the major projects under which the wartime research activities were conducted. Those scheduled for early publication and their group and volume editors are as follows: I. Electromagnetic Separation Project, R. K. Wakerling —Volume 5, *Characteristics of electrical discharges in magnetic fields,* R. K. Wakerling; II. Gaseous D sion Project, George M. Murp Volume 16, *Engineering develop of the Gaseous Diffusion Pro* Manson Benedict and C. Willi III. Special Separations Pro George M. Murphy—Volume 1, *theory of isotope separation,* Cohen; Volume 2, *The spectros and photochemical products of nium compounds,* G. H. Dieke an B. F. Duncan; Volume 4, *H water,* Harold C. Urey and Isa Kirschenbaum; IV. Plutonium P ect, Robert S. Mulliken — Vol 19B, *The thermodynamic prope of uranium compounds,* Law Quill; Volume 20A, *Industrial m cine,* Robert S. Stone; Volume *Histopathology of irradiation f external and internal sources,* Wil Bloom; V. Los Alamos Project, R Smith—Volume 1, *Experimental t niques,* William C. Elmore Matthew L. Sands; Volume 2, *Io tion chambers and counters,* B Rossi and Hans Staub; VI. Univer of Rochester Project, Donald Charles—Volume 1, *The pharma ogy and toxicology of uranium fluorine compounds,* Carl Voegtlin Harold C. Hodge; VII. Mate Procurement Project, Charles Sle —Volume 1, *Preparation, proper and technology of fluorine and rine compounds,* Charles Sles VIII. Manhattan Project, Clement Rodden and Eugene W. Rabinow —Volume 1, *The analytical chemi of the Manhattan Project,* Clement Rodden.

The Nepal Expedition, sponso by the National Geographic Soci Yale University, and the Smithson Institution, has received permis from Nepal's reigning Maharaja, Mohan Shum Shere Jung Baha Rana, to spend a month in the K nali River valley in western Ne from which all outsiders have pr ously been barred. A further c cession will allow the party to exp the valley of Sun Kosi in east Nepal. The expedition, which is rected by Dillon Ripley, of Yale U versity, arrived in Katmandu, cap of the kingdom, in mid-November has since been engaged in field w in the Terai, the lowlands to the s of Katmandu.

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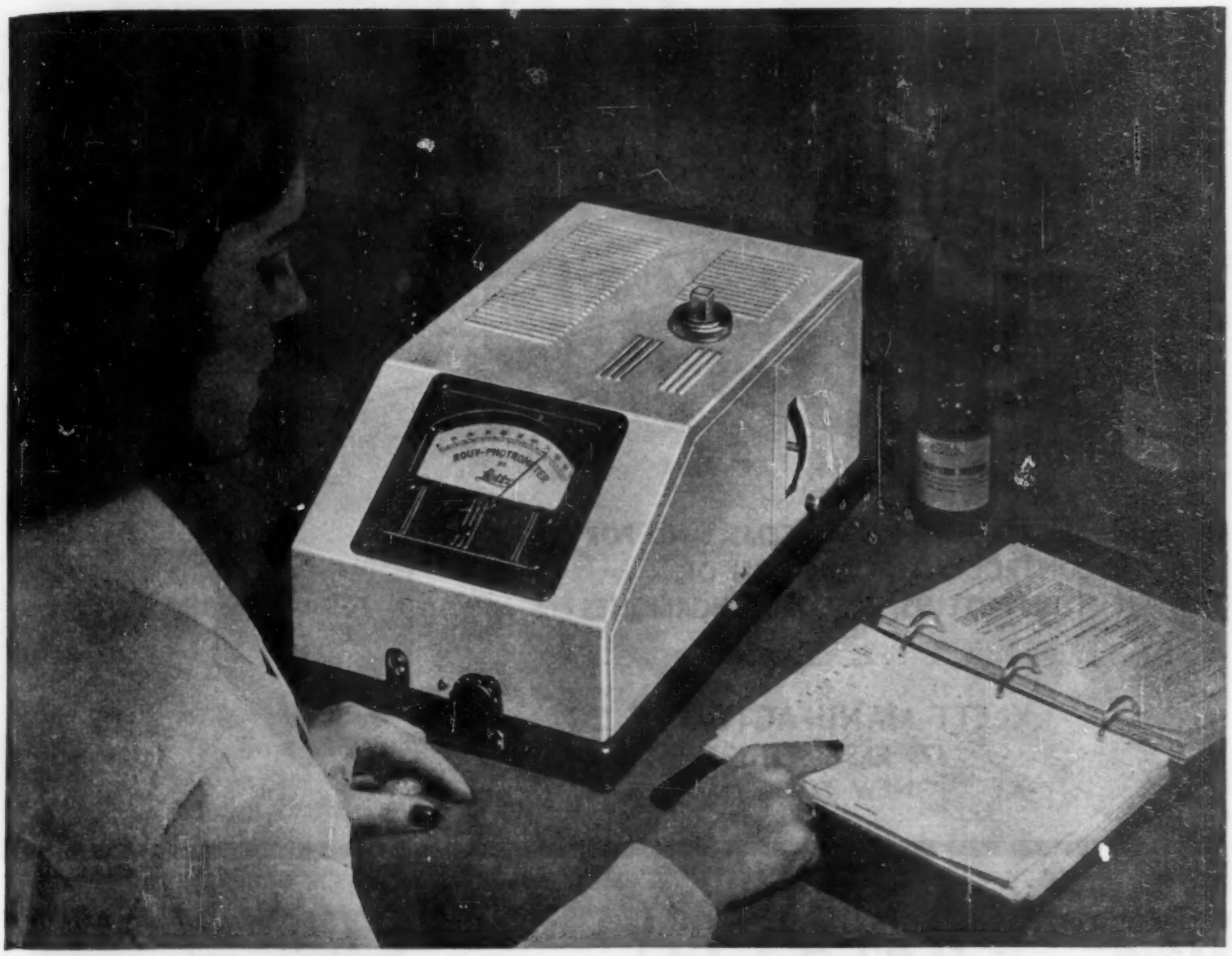

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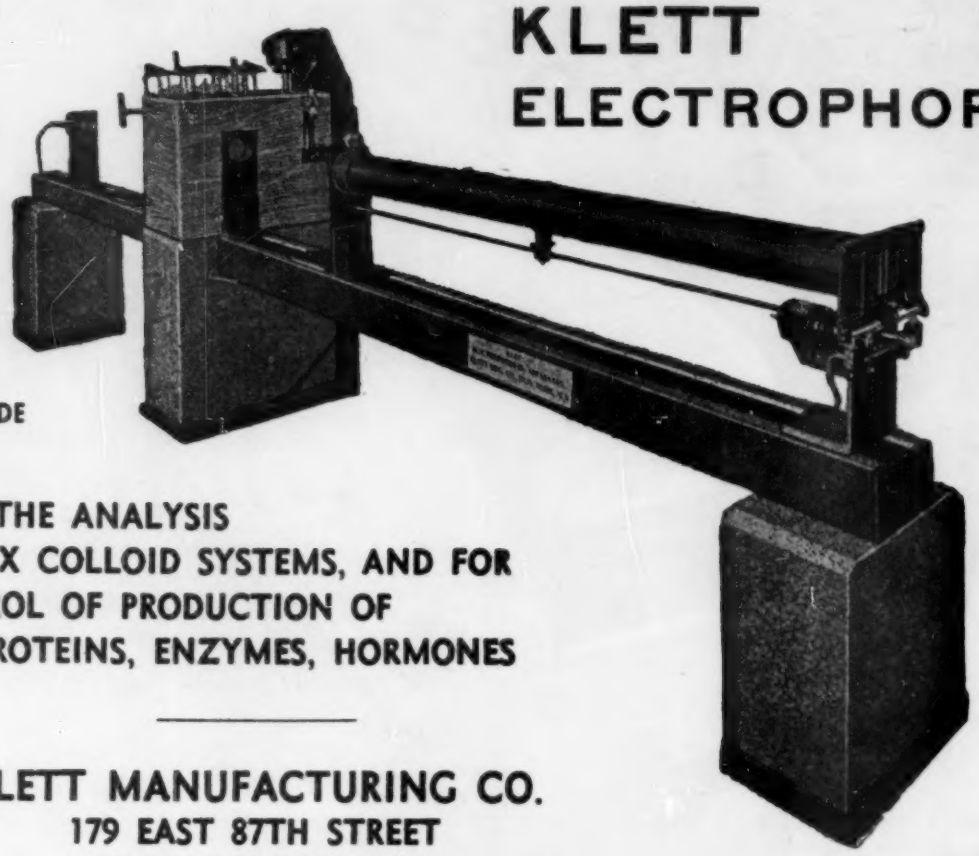

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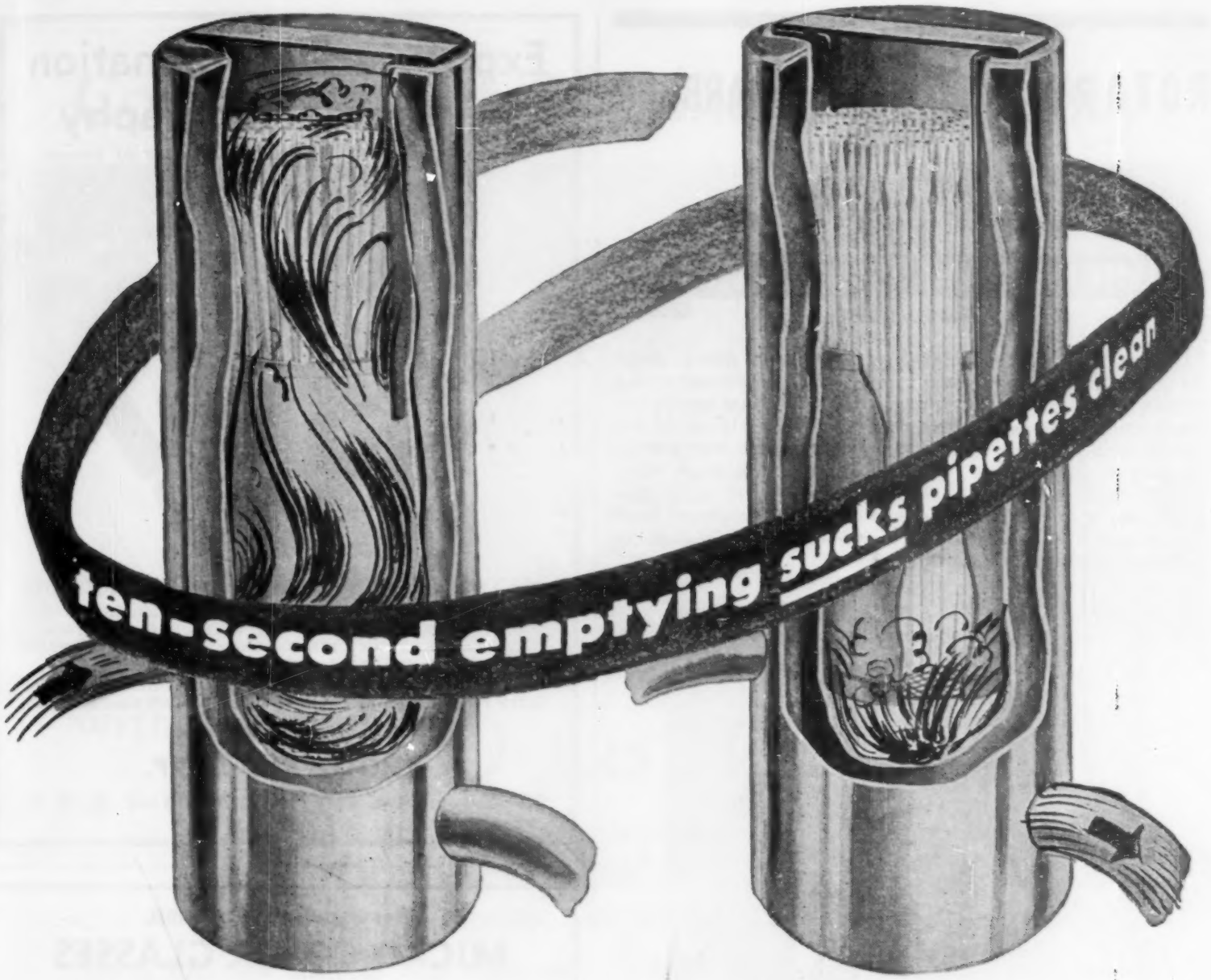

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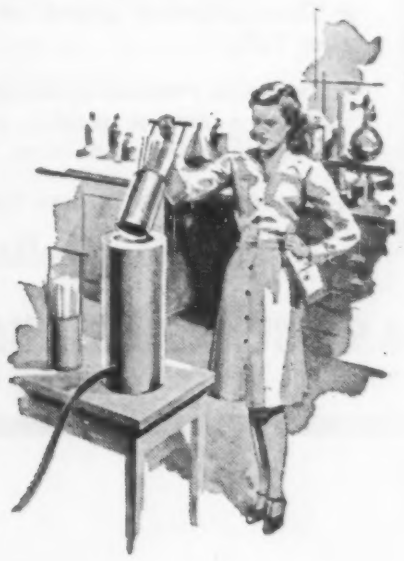

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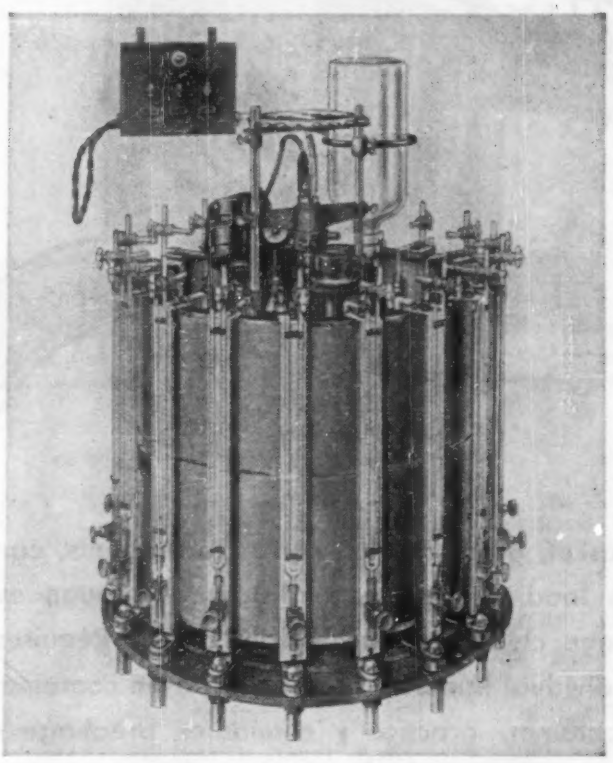

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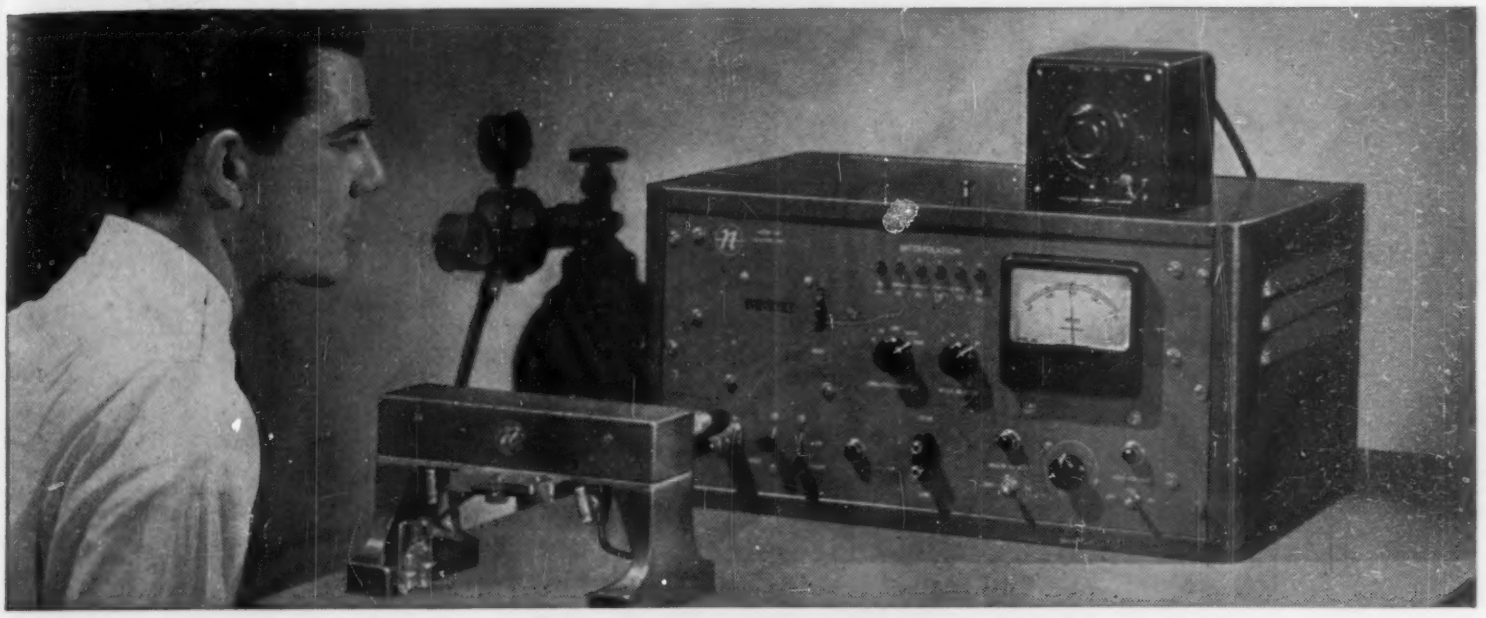

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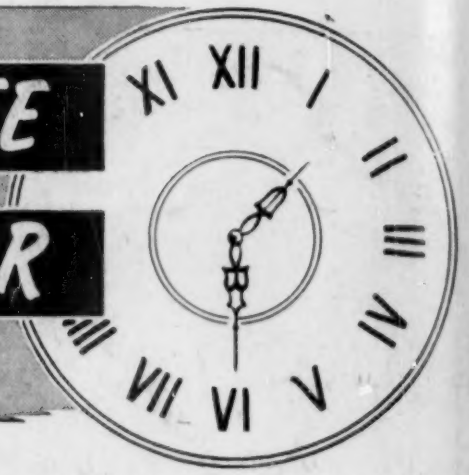

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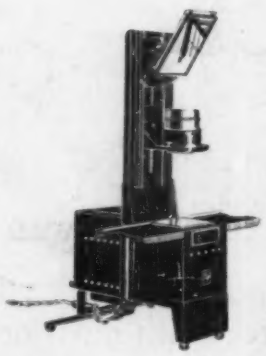

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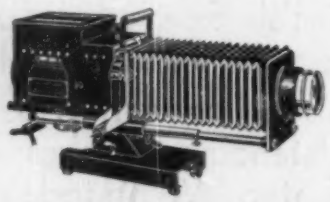

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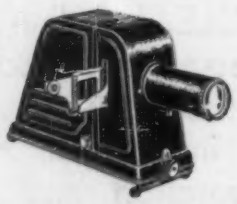

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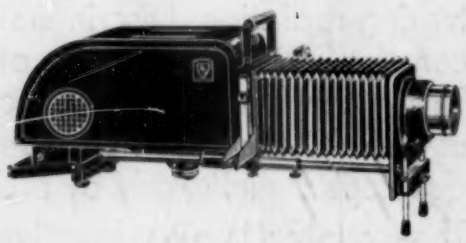

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